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Arakane

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(54) **INKJET PRINTER**

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B41J 29/393	(2006.01)
B41J 2/045	(2006.01)

(52) **U.S. Cl.**

CPC ***B41J 29/393*** (2013.01); ***B41J 2/04503*** (2013.01); ***B41J 2/04556*** (2013.01)

(58) **Field of Classification Search**

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USPC 347/8, 9, 14, 16, 37, 101, 104

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,874,979	A	2/1999	Ohyama
6,471,315	B1	10/2002	Kurata

(Continued)

FOREIGN PATENT DOCUMENTS

JP	HEI 05-155009 A	6/1993
JP	HEI 9-48161 A	2/1997

(Continued)

OTHER PUBLICATIONS

Notice of Allowance dated Feb. 11, 2015 issued in U.S. Appl. No. 14/107,035.

(Continued)

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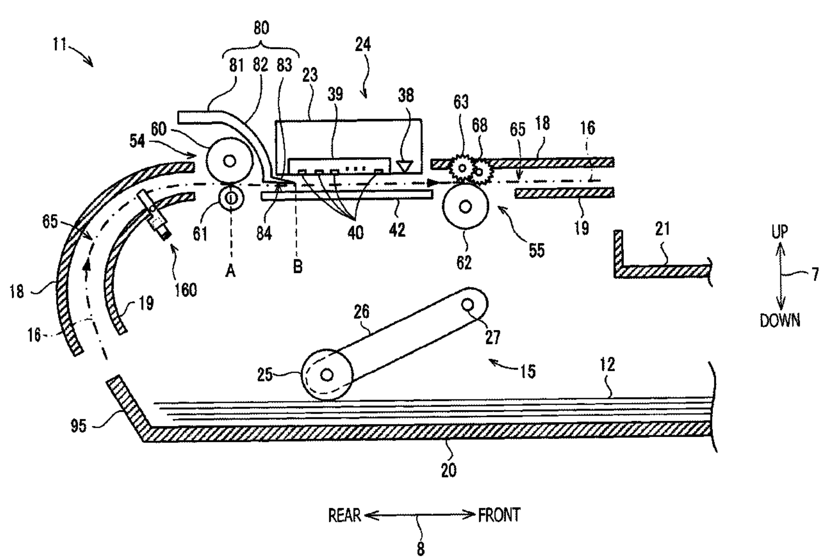
(57) **ABSTRACT**

An inkjet printer having a conveyer, a recording head, a carriage, a corrugation mechanism, and a controller is provided. The controller executes an operation including a conveying step to convey a sheet and a recording step to discharge ink toward the sheet. The recording step includes a first discharging step, in which the recording head is manipulated to discharge the ink toward a targeted position on the sheet along a scanning direction at a first discharging timing, and a second discharging step, in which the recording head is manipulated to discharge the ink toward the targeted position on the sheet at a second discharging timing which is deviated from the first discharging timing. The farther the targeted position is separated from a reference position on the sheet along the main scanning direction, the more largely the second discharging timing is deviated from the first discharging timing.

21 Claims, 13 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

7,237,858	B2 *	7/2007	Igarashi	347/8
8,567,905	B2 *	10/2013	Ogasawara	347/37
2004/0126164	A1	7/2004	Ohyama	
2005/0088471	A1	4/2005	Endo	
2007/0291056	A1	12/2007	Tanahashi et al.	
2009/0219322	A1	9/2009	Terada	
2010/0039473	A1	2/2010	Terada	
2010/0244357	A1	9/2010	Takahata	
2011/0063352	A1	3/2011	Sakurada et al.	
2011/0157269	A1	6/2011	Teramae	
2011/0175958	A1	7/2011	Sato et al.	
2011/0298854	A1	12/2011	Sakurada et al.	
2014/0168300	A1	6/2014	Kubo et al.	
2014/0204141	A1 *	7/2014	Arakane	347/14

FOREIGN PATENT DOCUMENTS

JP	HEI 11-240146	A	9/1999
JP	2004-017586	A	1/2004
JP	2004-106978	A	4/2004
JP	2005-246642	A	9/2005
JP	2006-102997	A	4/2006
JP	2006-192636	A	7/2006
JP	2007-144718	A	6/2007
JP	2007-331297	A	12/2007
JP	2007-331315	A	12/2007
JP	2008-221729	A	9/2008
JP	2009-128822	A	6/2009
JP	2009-143152	A	7/2009
JP	2009-196367	A	9/2009
JP	2009-202430	A	9/2009
JP	2009-208273	A	9/2009
JP	2010-042646	A	2/2010
JP	2011-079296	A	4/2011
JP	2014-136419	A	7/2014
JP	2014-139002	A	7/2014

OTHER PUBLICATIONS

U.S. Office Action dated Sep. 4, 2014 received in related U.S. Appl. No. 14/107,035.

U.S. Office Action dated Nov. 20, 2014 received in related U.S. Appl. No. 14/341,080.

U.S. Office Action dated Dec. 24, 2014 received in related U.S. Appl. No. 14/158,000.

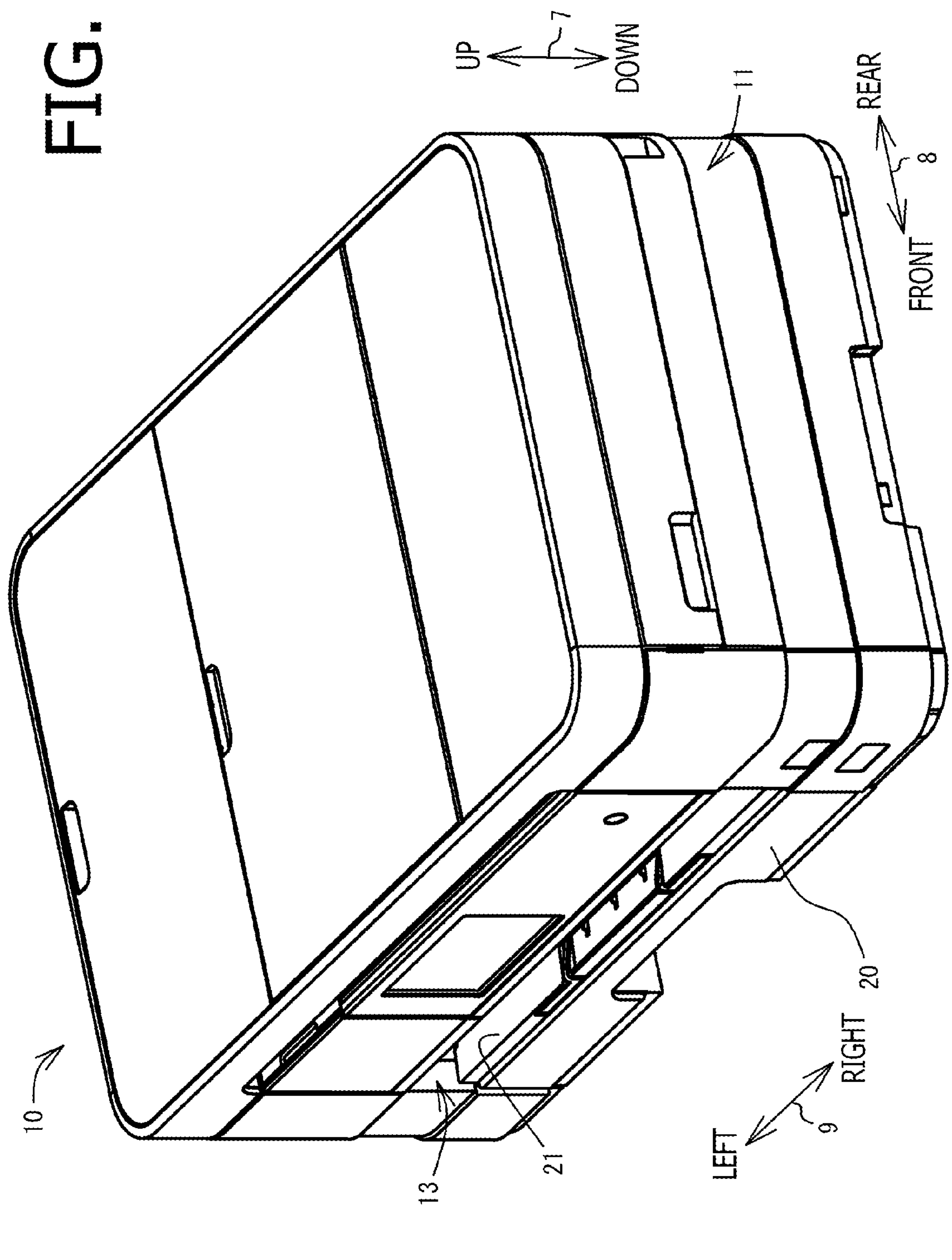
U.S. Appl. No. 14/341,080, filed Jul. 25, 2014.

U.S. Office Action dated Mar. 20, 2015 issued in U.S. Appl. No. 14/158,000.

Notice of Allowance dated Mar. 5, 2015 issued in U.S. Appl. No. 14/341,080.

* cited by examiner

FIG. 1



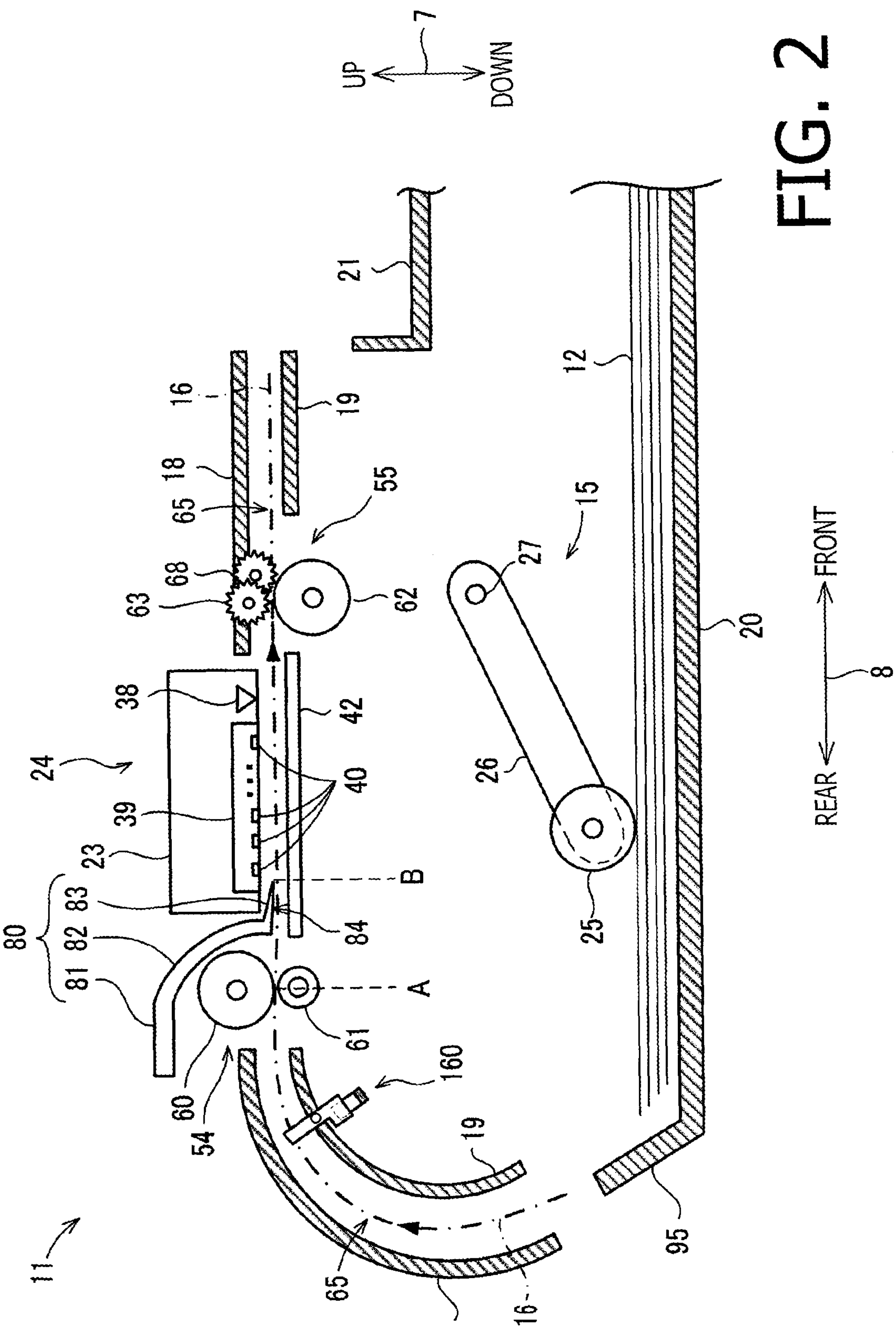

UP
DOWN
7
FRONT
REAR
8
A
B
11
12
15
16
18
19
20
21
23
24
25
26
27
38
39
40
42
54
55
60
61
62
63
65
68
80
81
82
83
84
95
160

FIG. 2

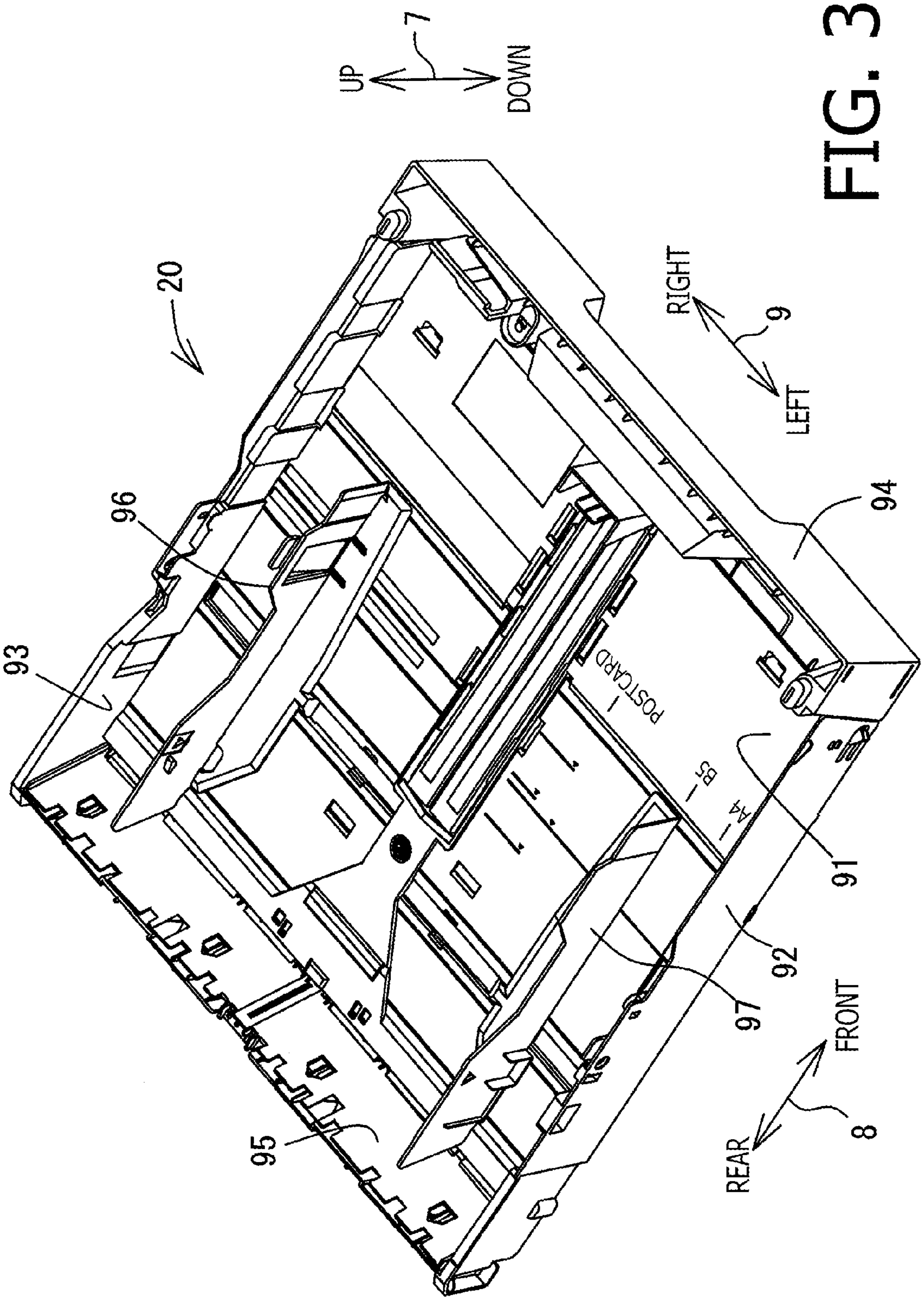

7
UP
DOWN
20
RIGHT
9
LEFT
94
96
93
POSTCARD
B5
A4
91
92
97
FRONT
REAR
8
95

FIG. 3

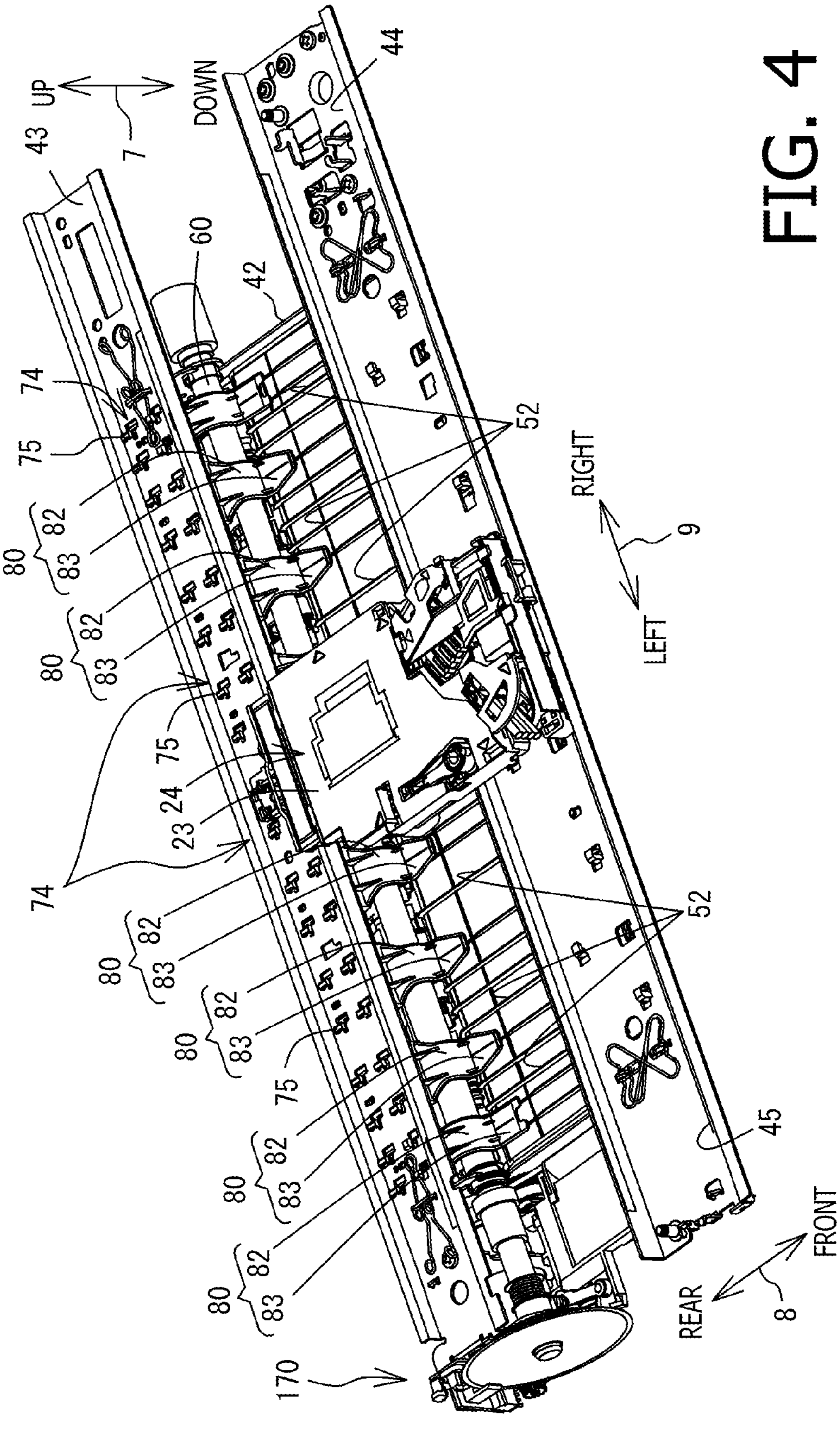

UP
DOWN
7
43
44
60
42
74
75
80
82
83
52
RIGHT
LEFT
9
23
24
45
170
REAR
FRONT
8

FIG. 4

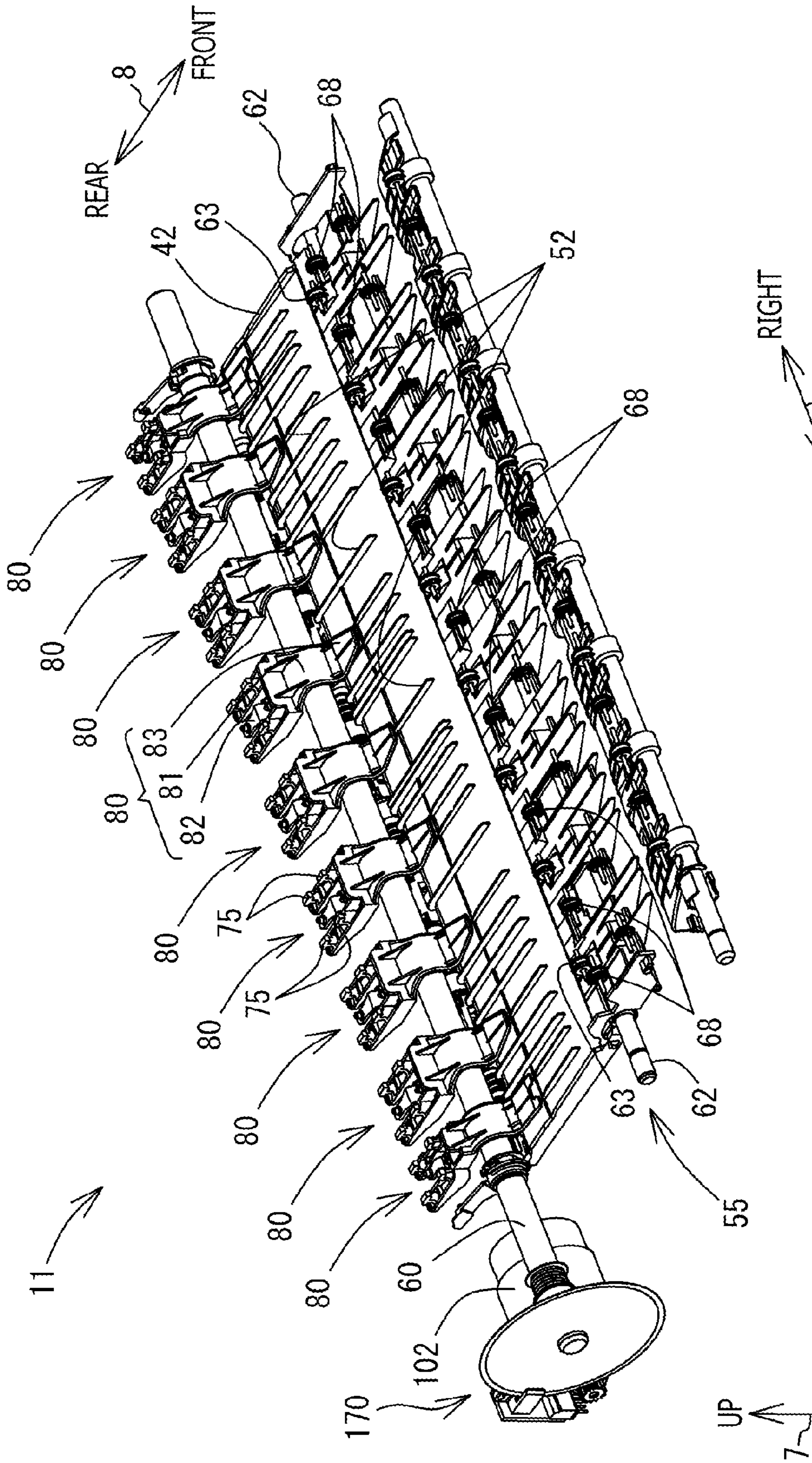

8
REAR
FRONT
62
68
63
42
52
RIGHT
9
LEFT
68
80
83
81
82
75
68
63
62
55
11
60
102
170
UP
7
DOWN

FIG. 5

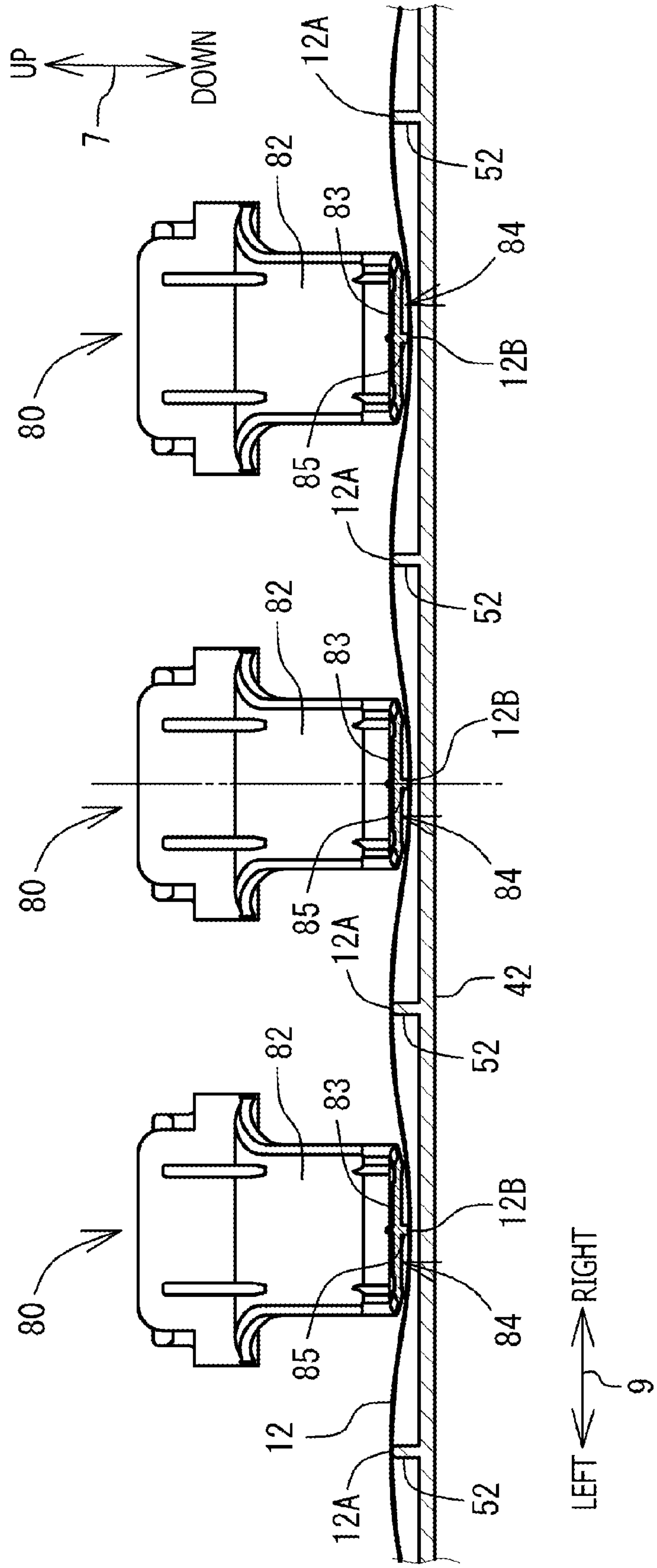

UP
DOWN
7
12A
52
82
83
84
80
12B
85
12A
52
82
83
12B
80
85
84
12A
42
52
82
83
12B
80
85
84
RIGHT
12
9
LEFT
12A
52

FIG. 6

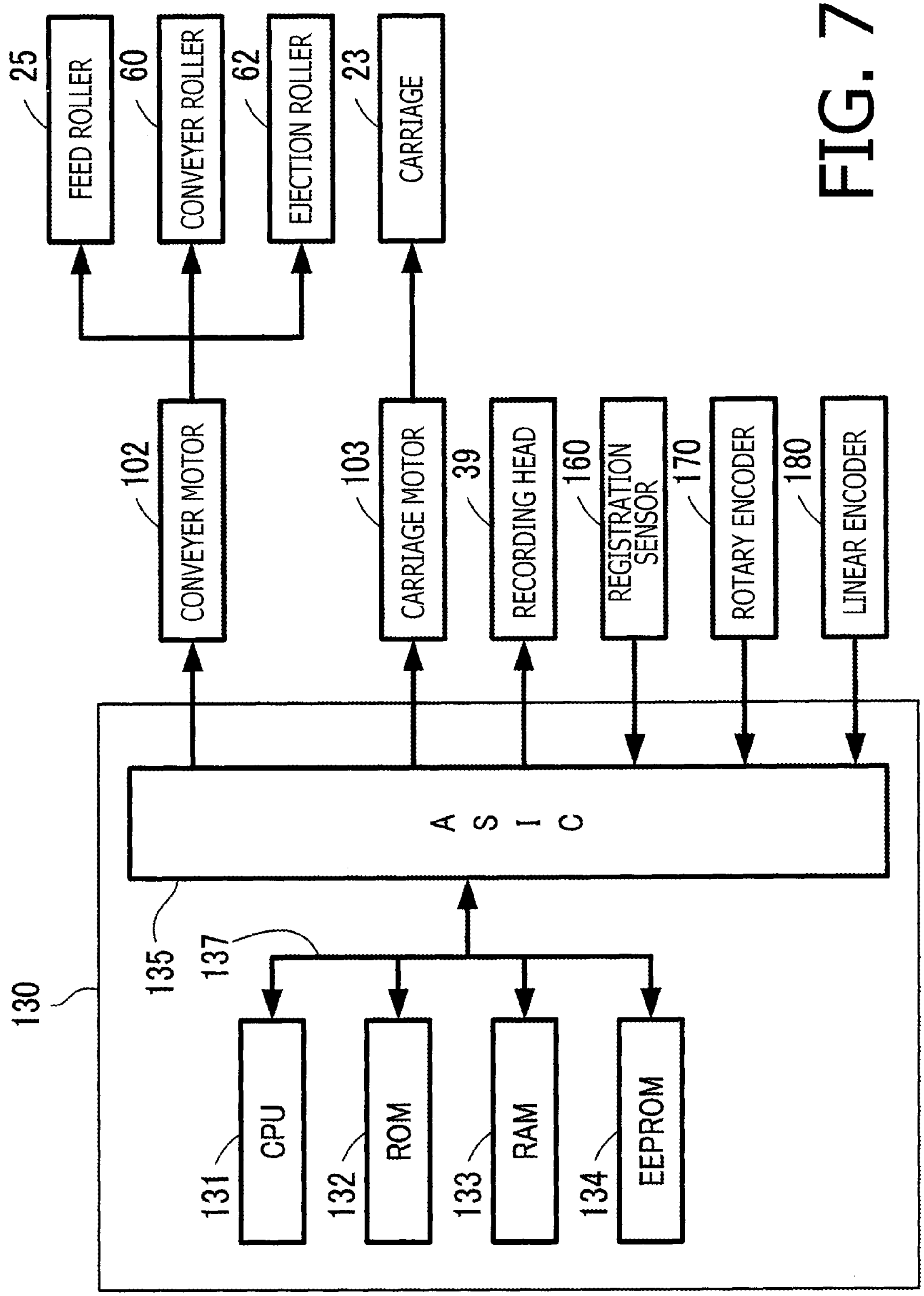

25
FEED ROLLER
60
CONVEYER ROLLER
62
EJECTION ROLLER
23
CARRIAGE
102
CONVEYER MOTOR
103
CARRIAGE MOTOR
39
RECORDING HEAD
160
REGISTRATION SENSOR
170
ROTARY ENCODER
180
LINEAR ENCODER
ASIC
130
135
137
131
CPU
132
ROM
133
RAM
134
EEPROM

FIG. 7

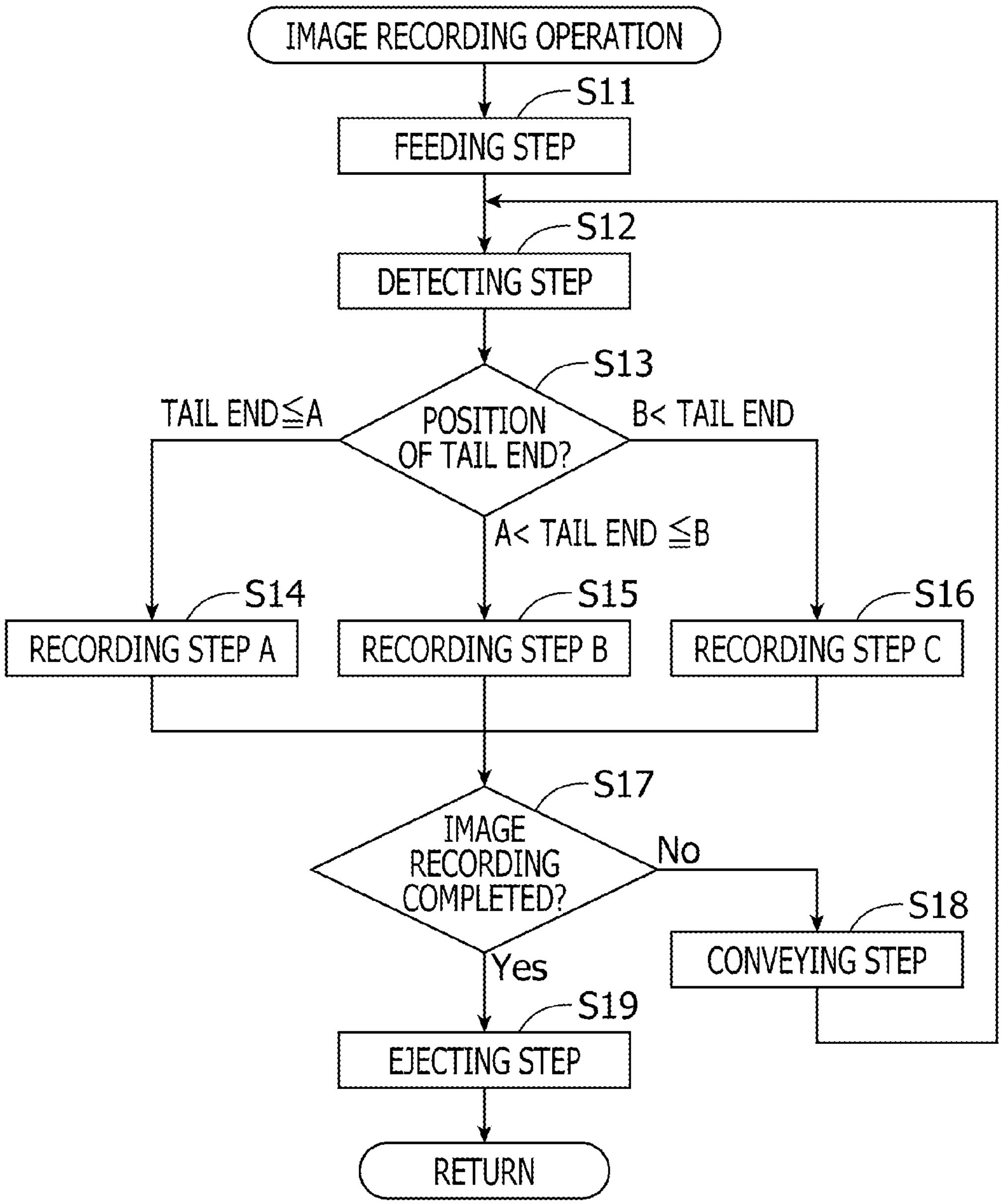


IMAGE RECORDING OPERATION
S11
FEEDING STEP
S12
DETECTING STEP
S13
POSITION OF TAIL END?
TAIL END≦A
B< TAIL END
A< TAIL END ≦B
S14
RECORDING STEP A
S15
RECORDING STEP B
S16
RECORDING STEP C
S17
IMAGE RECORDING COMPLETED?
No
S18
CONVEYING STEP
Yes
S19
EJECTING STEP
RETURN

FIG. 8

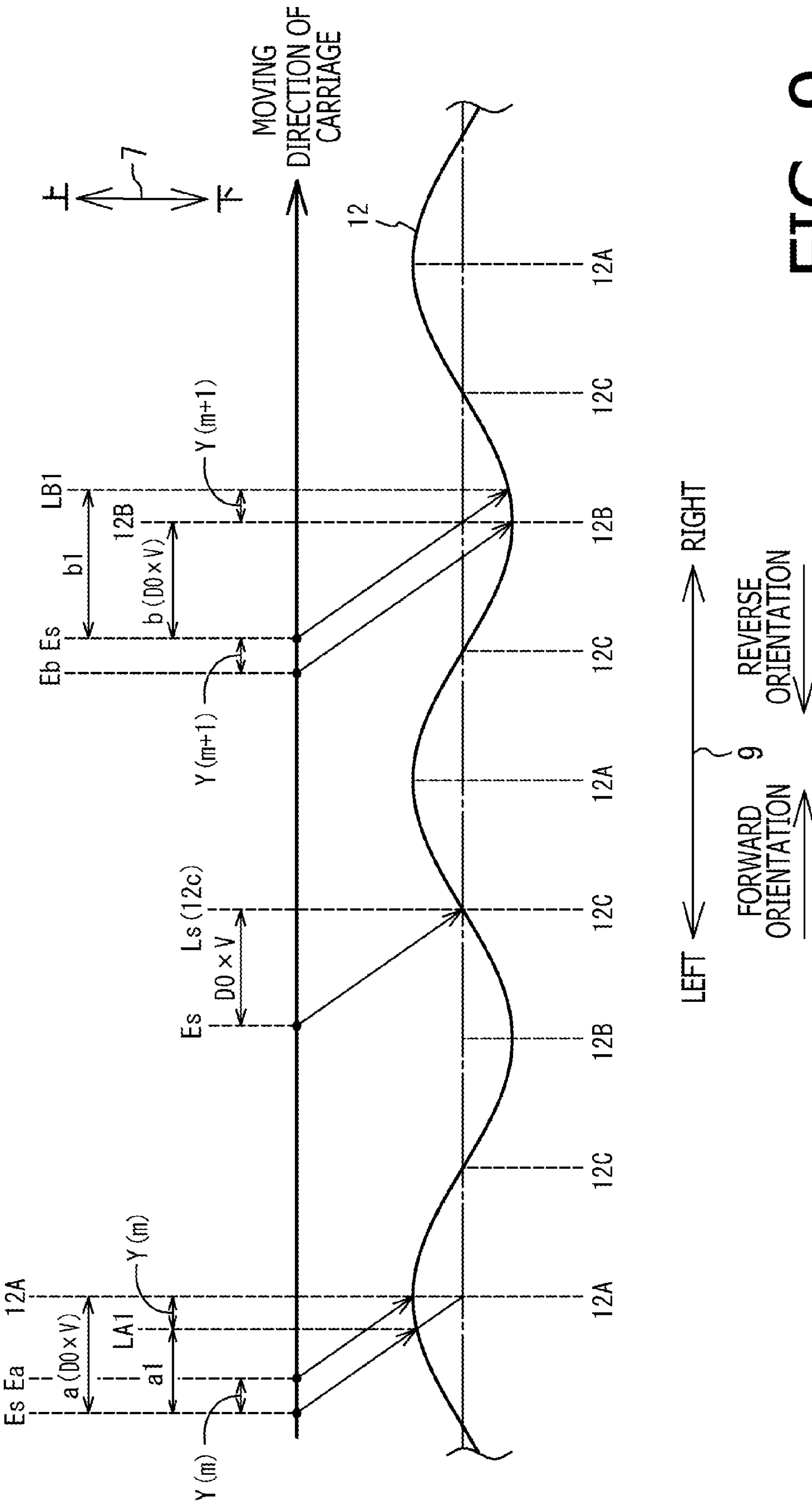

上
下
7
MOVING DIRECTION OF CARRIAGE
12
12A
12C
12B
12C
12A
12C
12B
12C
12A
LB1
Y (m+1)
12B
b1
b (D0×V)
Eb Es
Y (m+1)
Ls (12c)
D0×V
Es
12A
Y (m)
LA1
a (D0×V)
a1
Es Ea
Y (m)
LEFT
RIGHT
9
FORWARD ORIENTATION
REVERSE ORIENTATION

FIG. 9

FIG. 10

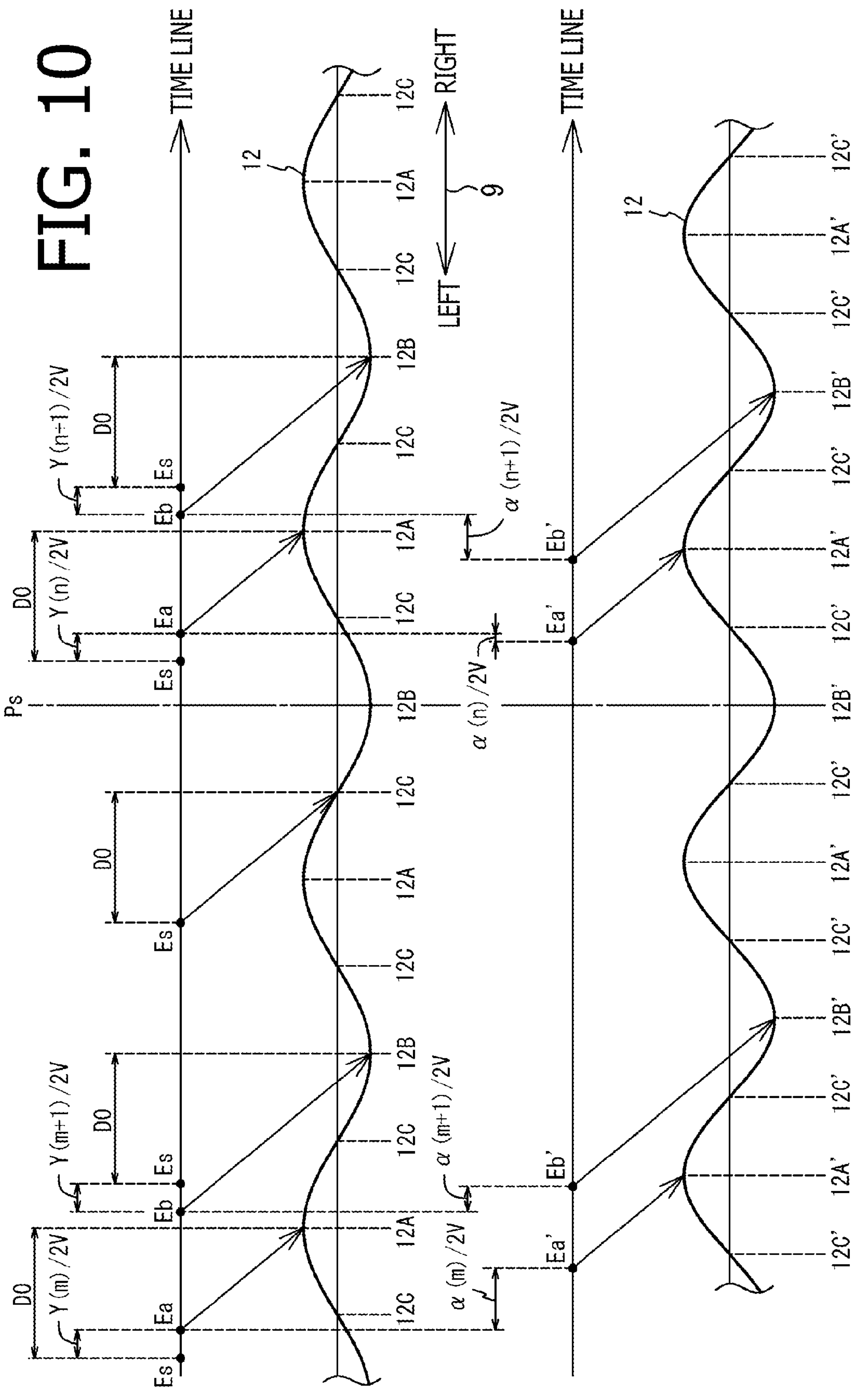
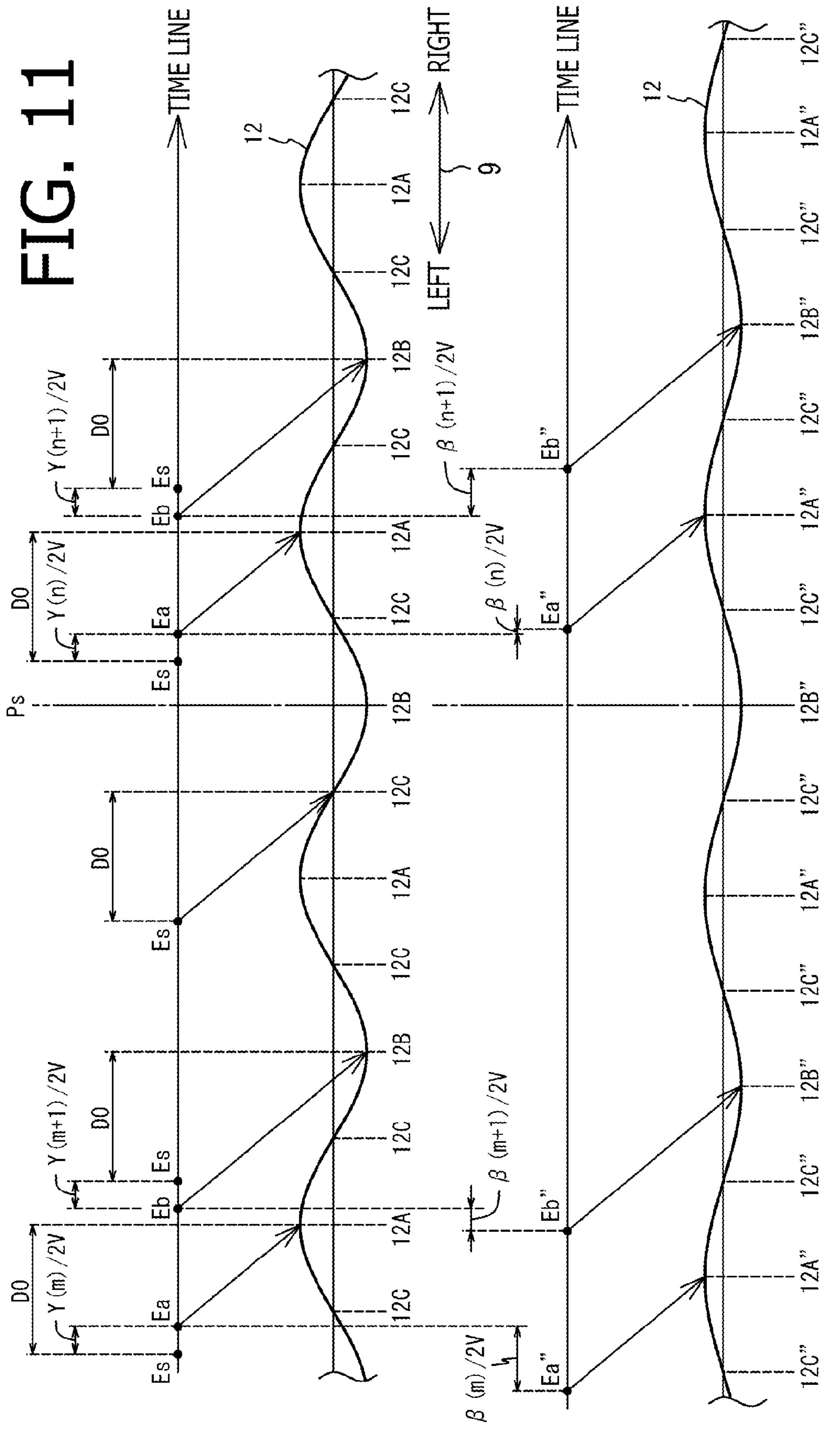

TIME LINE
RIGHT
LEFT
9
12
12A
12B
12C
12A'
12B'
12C'
Ps
Es
Ea
Eb
Ea'
Eb'
D0
Y (m) /2V
Y (m+1) /2V
Y (n) /2V
Y (n+1) /2V
α (m) /2V
α (m+1) /2V
α (n) /2V
α (n+1) /2V

FIG. 11


TIME LINE
RIGHT
LEFT
9
12
Ps
Es
Ea
Eb
D0
Y (m) /2V
Y (m+1) /2V
Y (n) /2V
Y (n+1) /2V
12A
12B
12C
Ea"
Eb"
β (m) /2V
β (m+1) /2V
β (n) /2V
β (n+1) /2V
12A"
12B"
12C"

REFERENCE VALUE	D0								
PEAK DEVIATION VALUE	$Y_{(2)}$	$Y_{(4)}$	$Y_{(6)}$	$Y_{(8)}$	$Y_{(10)}$	$Y_{(12)}$	$Y_{(14)}$	$Y_{(16)}$	
BOTTOM DEVIATION VALUE	$Y_{(1)}$	$Y_{(3)}$	$Y_{(5)}$	$Y_{(7)}$	$Y_{(9)}$	$Y_{(11)}$	$Y_{(13)}$	$Y_{(15)}$	$Y_{(17)}$
ADJUSTING VALUE α	$\alpha_{(1)}$	$\alpha_{(2)}$	$\alpha_{(3)}$	$\alpha_{(4)}$	$\alpha_{(5)}$	$\alpha_{(6)}$	...	$\alpha_{(16)}$	$\alpha_{(17)}$
ADJUSTING VALUE β	$\beta_{(1)}$	$\beta_{(2)}$	$\beta_{(3)}$	$\beta_{(4)}$	$\beta_{(5)}$	$\beta_{(6)}$	...	$\beta_{(16)}$	$\beta_{(17)}$

FIG. 12

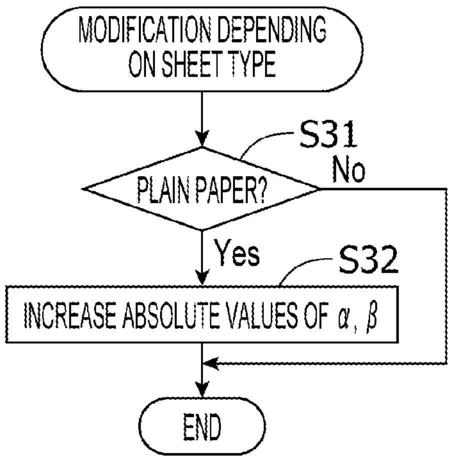


FIG. 13A

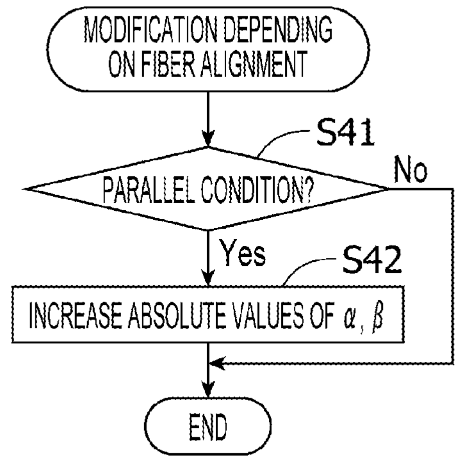


FIG. 13B

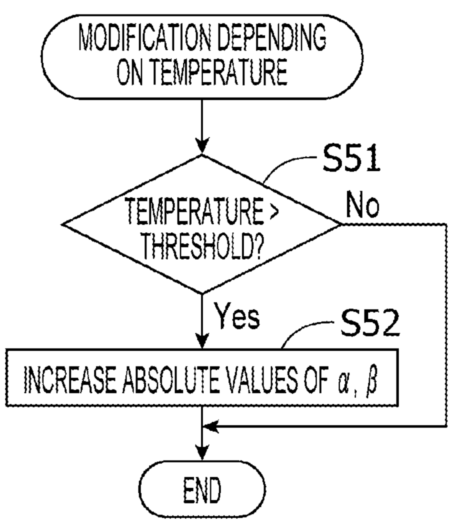


FIG. 13C

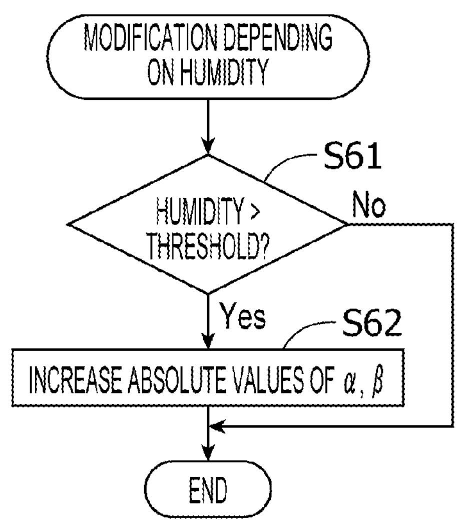


FIG. 13D

INKJET PRINTER

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority under 35 U.S.C. §119 from Japanese Patent Application No. 2013-156403 filed on Jul. 29, 2013. The entire subject matter of the application is incorporated herein by reference.

BACKGROUND

1. Technical Field

The following description relates to an inkjet printer.

2. Related Art

An inkjet printer configured to record an image by discharging ink onto a sheet is known. The inkjet printer may be configured to form the sheet into a corrugated shape waving up and down along a scanning direction, which intersects with a direction to convey the sheet. Such an inkjet printer may be equipped with a platen and a sheet-pressing plate. The platen may be formed to have convex portions and concave portions on an upper surface thereof. The sheet-pressing plate may be arranged in a position to face the platen. While the sheet is placed in a position between the platen and the sheet-pressing plate, the sheet may be deformed into the corrugated shape.

SUMMARY

In the inkjet printer mentioned above, an amount of amplitude of the sheet in a vertical direction and a dimension of the sheet in the scanning direction being placed in between the platen and the sheet-pressing plate may be different from those of a sheet not being in the position between the platen and the sheet-pressing plate. In other words, a shape of the sheet may vary depending on the positions in the inkjet printer; therefore, it may be required to adjust timings to discharge the ink onto the sheet depending on the positions.

Aspects of the present invention are advantageous in that an inkjet printer, in which ink is discharged onto a corrugated-shaped sheet in preferable timings adjusted in accordance with the shape of the sheet, is provided.

According to an aspect of the present invention, an inkjet printer is provided. The inkjet printer includes a conveyer configured to convey a sheet along a conveyance direction; a recording head configured to discharge ink toward the sheet being conveyed by the conveyer; a carriage mounting the recording head thereon and being configured to move along a scanning direction; a corrugation mechanism configured to shape into a corrugated shape, in which an amount of a gap between the recording head and the sheet is increased and decreased alternately along the scanning direction, at a corrugating position; and a controller. The controller is configured to execute an operation including a conveying step, in which the sheet is conveyed by the conveyer; and a recording step, in which the carriage is moved in the scanning direction and the recording head is manipulated to discharge the ink toward the sheet. The recording step includes a first discharging step, in which, after the conveying step and on condition that the sheet is present at the corrugating position, the recording head is manipulated to discharge the ink toward a targeted position on the sheet along the scanning direction at a first discharging timing; and a second discharging step, in which, after the conveying step and on condition that the sheet is absent at the corrugating position, the recording head is manipulated to discharge the ink toward the targeted position

on the sheet along the scanning direction at a second discharging timing which is deviated from the first discharging timing, the farther the targeted position being separated from a reference position on the sheet along the scanning direction, the more largely the second discharging timing being deviated from the first discharging timing.

According to another aspect of the present invention, a method to record an image on a sheet in an inkjet printer is provided. The method includes steps of conveying the sheet by a conveyer; and recording by moving a carriage in a scanning direction, and manipulating a recording head mounted on the carriage to discharge ink toward the sheet shaped into a corrugated shape along the scanning direction at a corrugating position. The step of recording includes a first discharging step, in which, after the conveying step and on condition that the sheet is present at the corrugating position, the recording head is manipulated to discharge the ink toward a targeted position on the sheet along the scanning direction at a first discharging timing; and a second discharging step, in which, after the conveying step and on condition that the sheet is absent at the corrugating position, the recording head is manipulated to discharge the ink toward the targeted position on the sheet along the scanning direction at a second discharging timing which is deviated from the first discharging timing, the farther the targeted position being separated from a reference position on the sheet along the scanning direction, the more largely the second discharging timing being deviated from the first discharging timing.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

FIG. **1** is an external perspective view of a multifunction device (MFD) **10**.

FIG. **2** is a cross-sectional view of an internal structure of a printer unit **11** in the MFD **10**.

FIG. **3** is a perspective view of a feeder tray **20** in the MFD **10**.

FIG. **4** is a perspective view of a recording unit **24** supported by guide rails **43**, **44** in the MFD **10**.

FIG. **5** is a perspective view of contact pieces **80** and a platen **42** in the MFD **10**.

FIG. **6** is a cross-sectional view to illustrate relative positions between supporting ribs **52** in the platen **42** and contacting ribs **85** in the contact pieces **80** in the MFD **10**.

FIG. **7** is a block diagram to illustrate configurations of a controller **130** and other related parts in the MFD **10**.

FIG. **8** is a flowchart to illustrate a flow of an image recording operation to be performed by the controller **130** in the MFD **10**.

FIG. **9** is a diagram to illustrate a reference value D0, a peak deviation value Y (m), and a bottom deviation value Y (m+1) with respect to the sheet **12** in the MFD **10**.

FIG. **10** illustrates a shape of the sheet **12** before a tail end of the sheet **12** passes through a position A and a shape of the sheet **12** after the tail end of the sheet **12** passes through the position A in the MFD **10**.

FIG. **11** illustrates a shape of the sheet **12** before the tail end of the sheet **12** passes through the position A and a shape of the sheet **12** after the tail end of the sheet **12** passes through the position B in the MFD **10**.

FIG. **12** illustrates a data structure in an EEPROM **134** in the MFD **10**.

FIG. **13**A is a flowchart to illustrate an operation to modify corrected discharging timings depending on a type of the sheet **12** in the MFD **10**. FIG. **13**B is a flowchart to illustrate an operation to modify corrected discharging timings depending on a fiber alignment in the sheet **12** in the MFD **10**. FIG. **13**C is a flowchart to illustrate an operation to modify corrected discharging timings depending on ambient temperature around the MFD **10**. FIG. **13**D is a flowchart to illustrate an operation to modify corrected discharging timings depending on ambient humidity around the MFD **10**.

DETAILED DESCRIPTION

Hereinafter, an embodiment according to aspects of the present invention will be described in detail with reference to the accompanying drawings. It is noted that various connections are set forth between elements in the following description. These connections in general, and unless specified otherwise, may be direct or indirect and that this specification is not intended to be limiting in this respect. Aspects of the invention may be implemented in computer software as programs storable on computer readable media including but not limited to RAMs, ROMs, flash memories, EEPROMs, CD-media, DVD-media, temporary storage, hard disk drives, floppy drives, permanent storage, and the like.

In the following description, a vertical direction **7** is defined with reference to an up-to-down or down-to-up direction for the MFD **10** in an ordinarily usable posture (see FIG. **1**). In other words, the up-to-down or down-to-up direction in FIG. **1** coincides with the vertical direction **7**. Further, other directions concerning the MFD **10** will be referred to based on the ordinarily usable posture of the MFD **10**: a viewer's lower-left side in FIG. **1**, on which an opening **13** is formed, is defined to be a front side of the MFD **10**, and a side opposite from the front side, i.e., a viewer's upper-right side, is defined as a rear side of the MFD **10**. A front-to-rear or rear-to-front direction is defined as a direction of depth and may be referred to as a front-rear direction **8**. An upper-left side in FIG. **1**, which comes on the user's left-hand side with respect to the MFD **10** when the user faces the front side, is referred to as a left side or a left-hand side. A side opposite from the left, which is on the viewer's lower-right side, is referred to as a right side or a right-hand side. A right-to-left or left-to-right direction of the MFD **10** may also be referred to as a right-left direction **9** or a widthwise direction **9**. The directions shown in FIGS. **2**-**6** and **9**-**11** correspond to those indicated by the arrows appearing in FIG. **1**.

[Overall Configuration of the MFD **10**]

As depicted in FIG. **1**, the MFD **10** has an overall shape of a six-sided rectangular box and contains a printer part **11**, in which an image can be recorded on a sheet **12** (see FIG. **2**) in an inkjet recording method, in a lower position thereof. In other words, the MFD **10** is equipped with a printing function. The MFD **10** is a multi-functional device having a plurality of functions, including, for example, a facsimile transmission receiving function, additionally to the printing function. In the following description, however, description of configurations concerning the functions other than the printing function will be omitted.

As depicted in FIG. **2**, the printer part **11** includes a feeder unit **15**, a feeder tray **20**, an ejection tray **21**, a conveyer roller unit **54**, a recording unit **24**, an ejection roller unit **55**, a platen **42**, corrugating spurs **68**, and contact pieces **80**. The feeder unit **15** is configured to pick up the sheet **12** from the feeder tray **20** and feed the picked-up sheet **12** in a conveyer path **65**. The conveyer roller unit **54** conveys the sheet **12** fed by the feeder unit **15** in the conveyer path **65** further toward a downstream along a direction of conveyance flow **16**. The recording unit **24** records an image on the sheet **12** conveyed by the conveyer roller unit **54**. The ejection roller unit **55** ejects the sheet **12** with the image recorded thereon by the recording unit **24** in the ejection tray **21**. The platen **42** supports the sheet **12** being conveyed by the conveyer roller unit **54** from below. The corrugating spurs **68** and the contact pieces **80** press the sheet **12** being conveyed by the conveyer roller unit **54** downward toward the platen **42**.

[Feeder Tray **20**]

The feeder tray **20** is inserted through the opening **13** along the front-rear direction **8** to be installed in the printer part **11** formed on the front side of the printer part **11**. The feeder tray **20** can support one or more sheets **12** to store therein. The ejection tray **21** is provided in an upper position with respect to the feeder tray **20**. The feeder tray **20** is, as shown in FIG. **3**, formed to have a shape of a top-open box, which includes a bottom panel **91**, a left-side panel **92**, a right-side panel **93**, a front panel **94**, and an oblique panel **95**. The front panel **94** projects upward from a front end of the bottom panel **91**. The ejection tray **21** is supported in the printer part **11** through the left-side panel **92**, the right-side panel **93**, and the front panel **94** (see FIG. **1**). The oblique panel **95** spreads upper-rearward from a rear end of the bottom panel **91** and guides the sheet **12** conveyed from the feeder unit **15** toward the recording unit **24**.

The bottom panel **91** is configured to support a plurality of predetermined sizes of sheet **12**, which include, for example, sizes of A4, B5, legal, and postcard. On a surface of the bottom panel **91**, widthwise end positions of the predetermined sizes on one side along the widthwise direction **9** (e.g., in FIG. **3**, left-side ends of the predetermined sizes) are marked. For example, in FIG. **3**, end positions of the A4, B5, and postcard sizes are indicated; however, the end marks are not necessarily limited to the above three sizes. On the bottom panel **91**, further, guide pieces **96**, **97**, which guide widthwise positions of the sheet **12** supported by the bottom panel **91**, are provided. The guide pieces **96**, **97** centers the sheet **12** on the bottom panel **91** at a center position along the widthwise direction **9** and restrict the sheet **12** from skewing. With the guide pieces **96**, **97**, a widthwise center of the sheet **12** is placed in a center-aligned position coincident with a widthwise center of the bottom panel **91**.

More specifically, when centering the sheet **12**, firstly, a user sets the sheet **12** on the bottom panel **91**. Secondly, the user slidably moves one of the guide pieces **96**, **97**, e.g., the guide piece **96**, leftward along the widthwise direction **9** to a position marked as the widthwise end of a correct sheet size for the sheet **12**. Thus, the guide piece **96** contacts a right-side end of the sheet **12**. In this regard, the other one of the guide pieces **96**, **97**, e.g., the guide piece **97**, is moved rightward in conjunction with the guide piece **96** via a pinion gear (not shown) until the guide piece **97** contacts a left-side end of the sheet **12**. Thus, the sheet **12** in one of the predetermined sizes placed on the bottom panel **91** is centered by the guide pieces **96**, **97** at the widthwise center position of the bottom panel **91**.

[Feeder Unit **15**]

As depicted in FIG. **2**, the feeder unit **15** is arranged in an upper position with respect to the feeder tray **20** being attached to the printer part **11** through the opening **13**. The feeder unit **15** includes a feed roller **25**, a feeder arm **26**, and a shaft **27**. The feed roller **25** is rotatably attached to one end of the feeder arm **26**, which is movable upward and downward to be closer to and farther from the feeder tray **20**. The feed roller **25** is rotatable by a driving force, which is generated by a conveyer motor **102** (see FIG. **7**). The feeder arm **26** is pivotably supported by the shaft **27**, which is supported by a frame (not shown) of the printer part **11**. The feeder arm **26** is urged downward by weight thereof and/or resilient force provided by, for example, a spring. When one or more sheets **12** are placed in the feeder tray **20**, and when the feed roller **25** rotates, a topmost one of the sheets **12** placed in the feeder tray **20** is picked up and fed in the conveyer path **65**.

[Conveyer Path **65**]

As depicted in FIG. **2**, the conveyer path **65** refers to an area partitioned by an outer guide member **18** and an inner guide member **19**, which are arranged in the printer part **11** to face each other. The conveyer path **65** rises from a rear end of the feeder tray **20** and curves upper-frontward in the printer part **11** to extend from the rear side along the recording unit **24** to the ejection tray **21**. More specifically, the conveyer path **65** extends through a nipped position in the conveyer roller unit **54**, a position between the platen **42** and a recording head **39**, and a nipped position in the ejection roller unit **55** to the ejection tray **21**. The conveyance flow **16** of the sheet **12** to be conveyed in the conveyer path **65** is indicated by a dash-and-dot line shown in FIG. **2**.

[Conveyer Roller Unit **54** and Ejection Roller Unit **55**]

As depicted in FIG. **2**, the conveyer roller unit **54** is disposed on a downstream side of the feeder unit **15** and on an upstream side of the recording unit **24** in the conveyer path **65** with regard to the direction of the conveyance flow **16**. The conveyer roller unit **54** includes a conveyer roller **60**, which is driven by the conveyer motor **102**, and a pinch roller **64**, which is rotated along with the rotation of the conveyer roller **60**. The conveyer roller **60** and the pinch roller **61** nip the sheet **12** in there-between and convey the sheet **12** in the direction of the conveyance flow **16**. Meanwhile, the ejection roller unit **55** is disposed on a downstream side of the recording unit **24** in the conveyer path **65** with regard to the direction of the conveyance flow **16**. The ejection roller unit **55** includes an ejection roller **62**, which is driven by the conveyer motor **102**, and a spur **63**, which is rotated along with the rotation of the ejection roller **62**. The sheet **12** can be conveyed by the conveyer roller unit **54** and the ejection roller unit **55** along the direction of the conveyance flow **16** in the conveyer path **65**.

[Platen **42**]

As depicted in FIG. **2**, the platen **42** is arranged in a position between the conveyer roller unit **54** and the ejection roller unit **55** along the direction of the conveyance flow **16**. The platen **42** is arranged to vertically face the recording unit **24** to support the sheet **12** being conveyed in the conveyer path **65** from below. As depicted in FIG. **5**, on an upper plane of the platen **42**, a plurality of supporting ribs **52** are formed to protrude upward and extend along the front-rear direction **8**. The supporting ribs **52** are formed in positions spaced apart from one another along the widthwise direction **9**. Therefore, the sheet **12** conveyed in the conveyer path **65** is supported by the platen **42**, or, more specifically, by the plurality of ribs **52** formed on the upper plane of the platen **42**.

[Recording Unit **24**]

As depicted in FIG. **2**, the recording unit **24** is arranged in a position between the conveyer roller unit **54** and the ejection roller unit **55** along the direction of the conveyance flow **16**. In this regard, the recording unit **24** is arranged in a position to face the platen **42** on an upper side of the conveyer path **65**. The recording unit **24** includes a carriage **23**, an encoder sensor **38**, a recording head **39**, and a nozzle **40**. The carriage **23** is movable along the widthwise direction **9** on the guide rails **43**, **44**. The encoder sensor **38** and the recording head **39** are mounted on the carriage **23**. The nozzle **40** is formed on a bottom of the recording head **39**. The guide rails **43**, **44** are, as shown in FIG. **4**, arranged to extend along the widthwise direction **9** and are spaced apart from each other along the front-rear direction **8**.

The carriage **23** is driven by a driving force from a carriage motor **103** (see FIG. **7**) to move in the widthwise direction **9**. Orientations (e.g., leftward or rightward) of the carriage **23** to move along the widthwise direction **9** can be switched by reversing rotation of the carriage motor **103**. The nozzle **40** is formed to discharge ink, which is supplied from an ink cartridge (not shown), in fine droplets there-through. Thus, the recording unit **24** discharges the ink droplets from the nozzle **40** toward the sheet **12** being supported by the platen **42** while the carriage **23** is moved in the widthwise direction **9**, and thereby, an image is recorded on the sheet **12**.

[Registration Sensor **160**]

As depicted in FIG. **2**, on an upstream side of the conveyer roller unit **54** with regard to the direction of the conveyance flow **16** in the conveyer path **65**, a known registration sensor **160** is disposed. The registration sensor **160** outputs sensor signals, which vary depending on presence of the sheet **12** in a sensor position. More specifically, on condition that the sheet **12** is at the sensor position where the registration sensor **160** is disposed in the conveyer path **65**, the registration sensor **160** outputs low-leveled signals to a controller **130**, which will be described later in detail. Meanwhile, on condition that the sheet **12** is absent at the sensor position, the registration sensor **160** outputs high-leveled signals to the controller **130**.

[Rotary Encoder **170**]

The MFD **10** includes a known rotary encoder **170** (see FIG. **4**), which generates pulse signals in accordance with rotation of the conveyer roller **60**. The rotary encoder **170** includes an encoder disk and an encoder sensor, which are not shown. The encoder disk rotates along with rotation of the conveyer roller **60**, and the optical sensor reads the rotating behavior of the encoder disk. Thus, the optical sensor generates pulse signals in accordance with rotation of the conveyer roller **60** and outputs the generated pulse signals to the controller **130**.

[Linear Encoder **180**]

On the guide rail **43**, as shown in FIG. **4**, an encoder strip **45**, which extends along the widthwise direction **9**, is arranged. The encoder strip **45** includes transparent portions and opaque portions, which are arranged alternately along a longitudinal direction thereof. Meanwhile, the encoder sensor **38** is mounted on the carriage **23** in a position to be able to face the encoder strip **45**. While the carriage **23** is moved along the widthwise direction **9**, the encoder sensor **38** detects the transparent portions and the opaque portions when passing them by and generates pulse signals according to the transparency and outputs the generated pulse signals to the controller **130**. The linear encoder **180** shown in FIG. **7** includes the encoder sensor **38** and the encoder strip **45**.

[Contact Pieces **80**]

As shown in FIG. **2**, on an upstream side of the recording head **39** with regard to the direction of the conveyance flow **16**, a plurality of contact pieces **80** are arranged. As shown in FIGS. **4** and **5**, the plurality of contact pieces **80** are arranged to be spaced apart from one another along the widthwise direction **9**. Each contact piece **80** includes, as shown in FIGS. **2** and **5**, a fixing portion **81**, a curved portion **82**, and a contact portion **83**.

The fixing portion **81** is formed in a shape of a thin plate. The contact piece **80** is fixed to the guide rail **43** at the fixing portion **81**. As shown in FIG. **5**, a plurality of (e.g., four) engageable parts **75** are formed to protrude upward from an upper plane of the fixing portion **81**. When the engageable parts **75** are engaged with openings **74**, which are formed in the guide rail **43**, the contact piece **80** is attached to a lower plane of the guide rail **43**. As shown in FIG. **2**, the curved portion **82** is formed to extend from the fixing portion **81** and curve lower-frontward toward the downstream of the conveyance flow **16**. At the lower-front end of the curved portion **82**, the contact portion **83** is formed to protrude frontward approximately along the direction of the conveyance flow **16**.

The contact portion **83** is formed in a shape of a thin plate and is, as shown in FIG. **6**, arranged in a position to vertically face the platen **42** along the vertical direction **7**. An amount of a gap between a lower surface **84** of the contact portion **83** and the platen **42** is smaller than an amount of a gap between the bottom plane of the recording head **39** and the platen **42** but is maintained to be substantially large to allow the sheet **12** to be conveyed in there-between smoothly. Thus, the contact portion **83** is arranged in a position between the carriage **23** and the platen **42** along a direction orthogonal to the direction of the conveyance flow **16** and to the main scanning direction. In other words, the contact portion **83** is arranged in a position between the carriage **23** and the platen **42** along the vertical direction **7**. On the lower surface **84** of the contact portion **83**, a contact rib **85** protruding downwardly is formed. While the sheet **12** is supported by the platen **42** from below, a lower end of the contact rib **85** contacts an upper surface of the sheet **12** of the sheet **12**. Thus, the sheet **12** is pressed downward toward the platen **42** by the contact portion **83** while the image may be formed on the upper surface of the sheet **12**.

As shown in FIG. **6**, while the plurality of supporting ribs **52** are formed to be spaced apart from one another along the widthwise direction **9**, the contact portions **83** of the contact pieces **80** are arranged in between the supporting ribs **52** of the platen **42**. Therefore, the supporting ribs **52** protrude toward the carriage **23** at intermediate positions between adjoining contact pieces **80**, which are arranged along the widthwise direction **9**. In other words, the contact ribs **85** and the supporting ribs **52** are arranged alternately along the widthwise direction **9**. Meanwhile, the supporting ribs **52** are formed to protrude to be higher than the lower ends of the contact ribs **85**. More specifically, the supporting ribs **52** contact the sheet **12** at positions closer to the recording head **39** than contact positions, at which the contact ribs **85** contact the sheet **12**.

When the sheet **12** is in the position between the platen **42** and the contact portions **83**, the sheet **12** is deformed into a corrugated shape waving up and down alternately along the widthwise direction when viewed from an upstream or a downstream position along the conveyance flow **16**. Downstream ends of the contact ribs **85** along the direction of the conveyance flow **16** are on a downstream position side of the conveyer roller unit **54** and on upstream position side of the recording head **39** with regard to the direction of the conveyance flow **16**. Thus, the contact pieces **80** and the supporting ribs **52** on the platen **42** serve as a corrugation mechanism, which forms the corrugated shape in the sheet **12**, and the corrugation mechanism is arranged in an area containing a corrugating position, which is between the conveyer roller unit **54** and the recording head **39**.

[Corrugating Spurs **68**]

The corrugating spur **68** is, as depicted in FIGS. **2** and **5**, disposed on a downstream side of the ejection roller unit **55** with regard to the direction of the conveyance flow **16**. The corrugating spur **68** includes, as shown in FIG. **5**, a plurality of corrugating spurs **68**, which are arranged to align along the widthwise direction **9** to be spaced apart from one another. The corrugating spurs **68** are arranged in lower positions than the spurs **63** in the ejection roller unit **55** with regard to height in the vertical direction **7**. Thus, the corrugating spurs **68** contact the upper surface of the sheet **12**. The corrugating spurs **68** are arranged in substantially coincident widthwise positions with the contact pieces **80**. In other words, each contact piece **80** and each corrugating spur **68** are arranged in a line along the front-rear direction **9**. Therefore, the corrugating spurs **68** contact substantially same areas in the sheet **12** as the contact pieces **80**. The corrugating spurs **68** serve as a part of the corrugation mechanism in the MFD **10**. The position, where the corrugating spurs **68** and the sheet **12** contact each other, may be referred to as the corrugating position according to the present embodiment and is on a downstream side of the ejection roller unit **55** with regard to the direction of the conveyance flow **16**.

Thus, the contact pieces **80** and the supporting ribs **52** on the platen **42** serve to form the corrugated shape in the sheet **12** at a portion where the sheet **12** faces the recording head **39**. In particular, the corrugated shape has peaks **12**A of protrusive mountain portions, protruding from a predetermined reference level, and bottoms **12**B of recessed valley portions, recessed from the reference level. And each of the peaks **12**A of protrusive mountain portions and each of the bottoms **12**B of recessed valley portions are positioned alternately along the widthwise direction **9**. More specifically, the peak **12**A refers to a position of boundary point, at which tendency of the amount of the gap between the recording head **39** and the sheet **12** along the widthwise direction **9** is turned from decreasing to increasing, in the protrusive mountain portion. When the sheet **12** is in a position between the platen **42** and the contact pieces **80**, the positions of the peaks **12**A substantially coincide with the positions of the supporting ribs **52** on the platen **42**. The bottom **12**B refers to a position of a boundary point, at which the tendency of the amount of the gap between the recording head **39** and the sheet **12** along the widthwise direction **9** is turned from increasing to decreasing, in the recessed valley portion. Therefore, when the sheet **12** is in a position between the platen **42** and the contact pieces **80**, the positions of the bottoms **12**B substantially coincide with the contact ribs **85** of the contact pieces **80** and the corrugating spurs **68**. Intermediate portions between the peaks **12**A and the bottoms **12**B form curves, which can be approximately expressed in a cubic function.

Meanwhile, in the present embodiment, as depicted in FIG. **4**, the contact pieces **80** are arranged at nine (9) positions along the widthwise direction **9** to be spaced apart from one another. As mentioned above, the bottoms **12**B of the sheet **12** are formed in the positions where the contact ribs **85** of the contact pieces **80** are arranged. Therefore, nine (9) bottoms **12**B are formed in the sheet **12**. In this regard, in order to avoid widthwise ends of the sheet **12** from being contacted by the recording head **39**, the sheet **12** is deformed to have the widthwise ends thereof to form the bottoms **12**B, to be apart from the recording head **39**. Therefore, while each peak **12**A is formed in between mutually adjoining two bottoms **12**B, eight (8) peaks **12**A are formed in the sheet **12**. According to the present embodiment, a position of one of the bottoms **12**B at a widthwise center, i.e., a fifth bottom **12**B from the right and left along the widthwise direction **9**, is referred to as a reference position. Generally, the reference position substantially coincides with a widthwise center of the sheet **12**.

[Controller **130**]

As depicted in FIG. **7**, the controller **130** includes a CPU (central processing unit) **131**, a ROM (read-only memory) **132**, a RAM (random access memory) **133**, an EEPROM (electrically erasable programmable read-only memory) **134**, and an ASIC (application specific integrated circuits) **135**, which are connected with one another by internal busses **137**. The ROM **132** stores programs to control behaviors of the CPU **131**. The RAM **133** is used as a memory area to temporarily store data and signals to be used in cooperation with the programs stored in the ROM **132** and as a work area to process the data. The EEPROM **134** stores data, such as configuration data and flags, which is to be saved even after power to the controller **130** is shut down.

The ASIC **135** is connected with the conveyer motor **102**, the carriage motor **103** and the recording head **39**. The ASIC **135** obtains driving signals to drive the conveyer motor **102** and the carriage motor **103** from the CPU **131** and outputs driving current to the conveyer motor **102** and the carriage motor **103** according to the driving signals. The conveyer motor **102** and the carriage motor **103** are driven by the driving current. For example, the controller **130** may control the conveyer motor **102** to rotate the rollers. At the same time, the controller **130** may control the carriage motor **103** to reciprocate the carriage **23**. Further, the controller **130** may control the recording head **39** to discharge the ink through the nozzles **40**.

The ASIC **135** is electrically connected with the registration sensor **160**, the rotary encoder **170**, and the linear encoder **180**. Based on the detected signals output from the registration sensor **160** and the pulse signals output from the rotary encoder **170**, the controller **130** detects a position of the sheet **12** in the conveying path **65**. Further, based on the pulse signals obtained from the linear encoder **180**, the controller **130** detects a position of the carriage **23** along the widthwise direction **9**.

[Image Recording Operation]

With reference to FIG. **8**, a flow of image recording operation executed by the MFD **10** will be described herein below. The flow described below may be executed by the CPU **131** reading the program from the ROM **132** or may be achieved by hardware circuits mounted on the controller **130**.

The controller **130** starts the flow shown in FIG. **8** on condition that an image recording instruction is entered by the user. The image recording instruction may be obtained from, but not limited to, an operation panel (not shown) provided in the MFD **10**, for example. For another example, the instruction may be entered from an external device through a communication network. The image recording instruction causes the controller **130** to drive the components including the rollers **25**, **60**, **62**, the carriage **23**, and the recording head **39**, to record an image on the sheet **12**. The image recording instruction may include, for example, image data, sheet-type information, and fiber-alignment information. The image data may be data representing the image to be recorded on the sheet **12**. The sheet-type information may indicate a type of the sheet **12** (e.g., regular paper or glossy paper) to be used in the image recording operation. The fiber-alignment information may indicate an orientation (e.g., crosswise or lengthwise) of fiber contained in the sheet **12** to be used.

[Feeding Step (S**11**)]

When the image recording instruction is entered, in S**11**, the controller **130** conducts a feeding step to feed the sheet **12** supported by the feeder tray **20** to a recording-start position. More specifically, the controller **130** controls feeding of the sheet **12** from the feeder tray **20** by activating the conveyer motor **102** and thereby rotates the feed roller **25**, and controls conveying of the sheet **12** to the recording-start position by activating the conveyer motor **102** and thereby rotates the conveyer roller **60**. The recording-start position refers to a position, at which an area for forming an initial part of the image in the sheet **12** and the nozzles **40** of the recording head **39** confront each other. The controller **130** may determine that the sheet **12** reaches the conveyer roller unit **54** and the recording-start position based on combination of the detected signals output from the registration sensor **160** to the controller **130** and the pulse signals output from the rotary encoder **170** to the controller **130**. In the feeding step in S**11** and a conveying step in S**18**, which will be described below, the sheet **12** is conveyed for a predetermined linefeed amount along the direction of the conveyance flow **16**.

[Detecting Step (S**12**)]

Next, in S**12**, the controller **130** conducts a detecting step, in which a position of a tail end of the sheet **12** conveyed in the feeding step (S**11**) or in the conveying step (S**18**) is detected. The tail end of the sheet **12** refers to an upstream end of the sheet **12** being conveyed with regard to the direction of the conveying flow **16**. In S**12**, more specifically, the controller **130** detects the position of the tail end of the sheet **12** based on combinations of the detected signals output from the registration sensor **160** and the pulse signals output from the rotary encoder **170**. In S**13**, the controller **130** determines a step to conduct among recording steps A (S**14**), B (S**15**), and C (S**16**) depending on the detected position of the tail end of the sheet **12** with respect to positions A and B (see FIG. **2**). The position A shown in FIG. **2** is a nipping position, in which the conveyer roller unit **54** can nip the sheet **12**. The position B shown in FIG. **2** is the position of the downstream ends of the contact ribs **85** with regard to the direction of the conveyance flow **16**, i.e., the corrugating position.

Among the recording steps A-C, the controller **130** conducts the recording step A in S**14** on condition that the lower-leveled signals are output from the registration sensor **160**, that is, if the tail end of the sheet **12** has not passed through the conveyer roller unit **54**. In other words, when the tail end of the sheet **12** is on the upstream side of the position A with regard to the direction of the conveyance flow **16** (S**13**: the tail end≤A), the flow proceeds from S**13** to S**14**. In this regard, the controller **14** counts a number of pulse signals, which are output from the rotary encoder **170** from a point when the signals output from the registration sensor **160** change from the low-leveled signals to the high-leveled signal. On condition that the counted number of the pulse signals is smaller than a first threshold, the controller **130** executes the recording step A in S**14**. At this moment, the tail end of the sheet **12** has not passed through the conveyer roller unit **54** (S**13**: the tail end≤A). The first threshold is a value, which indicates a distance between the sensor position of the registration sensor **160** and the position A along the conveyance flow **16** or a count of the pulse signals corresponding to the distance.

Meanwhile, among the recording steps A-C, the controller **130** conducts the recording step B in S**15** on condition that the counted number of pulse signals indicates a value greater than or equal to the first threshold and smaller than a second threshold. In this regard, the second threshold is greater than the first threshold. That is, when the tail end of the sheet **12** has passed through the conveyer roller unit **54** but not has passed through the corrugating position yet, the controller **130** conducts the recording step B in S**15**. In other words, when the tail end of the sheet **12** is between the position A and the position B with regard to the conveyance flow **16** (S**13**: A<tail end≤B), the controller **130** conducts the recording step B in S**15**. On the other hand, on condition that the counted number of the pulse signals is greater than or equal to the second threshold, the controller **130** conducts the recording step C in S**16**, which will be described below. That is, when the tail end of the sheet **12** has passed through the corrugating position, the controller **130** conducts the recording step in S**16**. In other words, when the tail end of the sheet **12** is on a downstream side of the position B with regard to the conveyance flow **16** (S**13**: B<tail end), the controller **130** conducts the recording step C. In this regard, the second threshold is a value, which indicates a distance between the sensor position of the regis-

tration sensor **160** and the position B along the conveyance flow **16** or a count of the pulse signals corresponding to the distance.

[Recording Steps (S**14**-S**16**)]

Following S**13**, the controller **130** conducts one of the recording steps S**14**-S**16**, in which the controller **130** manipulates the carriage motor **103** to move the carriage **23** in the widthwise direction **9** and the recording head **39** to discharge the ink at predetermined discharging timings. In this regard, the discharging timings to discharge the ink at a same targeted position vary among the recording steps A, B, C.

The recording steps A-C in S**14**-S**16** to be conducted by the controller **130** will be described with reference to FIGS. **9**-**12**. In FIG. **9** and upper rows in FIGS. **10**-**11**, a corrugated shape of the sheet **12** along the widthwise direction **9** while the tail end has not passed through the conveyer roller unit **54** yet in S**13** (S**13**: tail end≤A) is illustrated. A lower row in FIG. **10** shows a shape of the sheet **12** while the sheet **12** is under the condition where the tail end has passed through the conveyer roller unit **54** but has not passed through the corrugating position yet (S**13**: A<tail end≤B). A lower row in FIG. **11** shows a shape of the sheet **12** while the sheet **12** is under the condition where the tail end has passed through the corrugating position (S**13**: B<tail end). In the following description, behaviors of the controller **130** with regard to the carriage **23** traveling in the forward orientation FWD (e.g., rightward) will be described. However, the behaviors of the controller **130** with regard to the carriage **23** traveling in a reverse orientation RVS (e.g., leftward), which is from the right-hand side toward the left-hand side, can be similarly explained by reversing the right and the left.

[Recording Step A (S**14**)]

In the MFD **10** according to the present embodiment, when the ink droplet discharged from the recording head **39** is landed at a specific targeted position on the sheet **12**, it is necessary that the controller **130** controls the nozzle **40** to discharge the ink droplet before the nozzle **40** reaches a position straight above the targeted position in consideration of time lag required for the discharged ink to travel through the gap between the nozzle **40** and the sheet **12**. Further, it is noted that the sheet **12** conveyed to the recording-start position in the corrugation mechanism is deformed in the corrugated shape with the peaks **12**A and the bottoms **12**B as indicated in a solid corrugating line shown in FIG. **9**. In other words, as the recording head **39** is moved along the widthwise direction **9**, the amount of the gap between the nozzle **40** and the sheet **12** fluctuates to be larger and smaller in the vertical direction **7** alternately. Therefore, it is necessary that the controller **130** adjust the discharging timings of the ink in consideration of the amount of fluctuated gap. For example, the controller **130** adjusts the discharging timing of the ink to be delayed later as the amount of the gap is smaller, and meanwhile, the controller **130** adjusts the discharging timing of the ink to be advanced earlier as the amount of the gap is larger.

Therefore, the controller **130** determines timings to discharge the ink toward a targeted position on each peak **12**A and each bottom **12**B on the sheet P respectively in consideration of the amount of gap fluctuation. More specifically, the controller **130** obtains a reference value D0, peak deviation values Y(m), which correspond to the peaks **12**A respectively, and bottom deviation values Y(m+1), which correspond to the bottoms **12**B respectively, from the EEPROM **134**. The values to be obtained from the EEPROM **134** may be achieved from experiments and/or simulations and factory-installed in the EEPROM **134** prior to shipping of the MFD **10**.

[Reference Value D0]

The reference value D0 indicates a reference timing for the ink to be discharged to land on a reference landing position Ls on the sheet **12**. More specifically, the reference value D0 indicates a time period, which is required for the ink discharged from the nozzle **40** to land on a reference landing position Ls. The reference landing position Ls is set in a center position **12**C between a mutually adjoining peak **12**A and bottom **12**B (i.e., a level of the sheet **12** when amplitude is zero) along the vertical direction **7**, i.e., a direction along which the recording head **39** and the sheet **12** face each other. Meanwhile, the reference value D0 also corresponds to a time period, which is required by the carriage **23** (more specifically, the recording head **39**) to move from a reference discharging position Es to a position straight above the reference landing position Ls. Therefore, when a moving velocity of the carriage **23** is expressed by "V", a distance between the reference discharging position Es and the reference landing position Ls along the widthwise direction **9** is expressed as D0*V. In the following description, when the position of the carriage **23** is referred to, it may be interpreted as a position of the recording head **39**.

For example, when the carriage **23** moving in the forward orientation FWD reaches the reference discharging position Es and discharges the ink from the recording head **39** thereat, the ink lands on the reference landing position Ls on the sheet **12** after D0 second, i.e., after the time period indicated by the reference value D0. Meanwhile, the carriage **23** reaches the position straight above the reference landing position Ls D0 second after the discharge of the ink at the reference discharging position Es. In other words, in order for the discharged ink to land on the reference landing position Ls, the ink should be discharged D0 second before the carriage **23** reaches the position straight above the reference landing position Ls, i.e., when the carriage **23** is at the reference discharging position Es. Thus, the reference value D0 specifies the discharging timing for the ink to be discharged and land on the intermediate position C (i.e., on the reference landing position Es).

The above-mentioned center position **12**C may not necessarily be limited to the vertically center position between the mutually adjoining peak **12**A and bottom **12**B. For example, the center position **12**C may be set at an average level between one of the peaks **12**A closest to the recording head **39** along the vertical direction **7** and one of the bottoms **12**B farthest from the recording head **39** along the vertical direction **7**. For another example, the center position **12**C may be set at an average level between an average level among levels of the plurality of peaks **12**A and an average level among levels of the plurality of bottoms **12**B along the vertical direction **7**. The reference value D0 is commonly applied to every targeted position on the sheet **12**. Meanwhile, the reference value D0 may not necessarily be limited to the example described above but may include, for example, a plurality of reference values. For example, a first reference value, which is used when the discharging timings for the ink to be discharged to land on the peaks **12**A are determined, and a second reference value, which is used when the discharging timings for the ink to be discharged to land on the bottoms **12**B are determined, may be included and stored in the EEPROM **134**.

[Peak Deviation Value Y(m)]

An example, when the recording head **39** discharges the ink toward the peak **12**A on the sheet **12**, indicated by the solid corrugating line in FIG. **9**, will be described. While the carriage **23** is moving in the forward orientation FWD along the widthwise direction **9**, the recording head **39** targets the ink to land on the peak **12**A and discharges the ink D0 second before the carriage **23** reaches the position straight above the peak **12**A at the reference discharging position Es. In this regard, however, the ink lands on an upstream (leftward) position than the targeted peak **12**A with regard to the forward orientation FWD (rightward), at a landing position LA1. Thus, a distance a1 between the reference discharging position Es and the landing position LA1 along the widthwise direction **9** is smaller than a distance a (i.e., D0*V) between the reference discharging position Es and the targeted peak **12**A along the widthwise direction **9** (distance a1<distance a). A deviated amount between the distance a1 and the distance a is represented by the peak deviation value Y(m).

Therefore, it is necessary that the controller **130** manipulates the recording head **39** to discharge the ink targeted at the peak **12**A at a peak-targeted discharging position Ea (see FIG. **9**), which is deviated from the reference discharging position Es upstream with regard to the forward orientation FWD for the amount indicated by the peak deviation amount Y(m). Thus, the peak deviation value Y(m) indicates the distance between the reference discharging position Es, at which the recording head **39** should discharge the ink toward the center position **12**C, and the peak-targeted discharging position Ea, at which the recording head **39** should discharge the ink toward the peak **12**A, along the widthwise direction **9**. Namely, the peak deviation value Y(m), which specifies the discharging timing for the ink to be discharged to land on the peak **12**A, is obtained by correctly delaying the discharging timing for the ink to be discharged at the center position **12**C, which is specified by the reference value D0. In other words, the peak deviation value Y(m), which is obtained by correcting the reference discharging position Es, provides the peak-targeted discharging position Ea.

[Bottom Deviation Value Y(m+1)]

An example, when the recording head **39** discharges the ink at the bottom **12**B on the sheet **12**, indicated by the solid corrugating line in FIG. **9**, will be described. While the carriage **23** is moving in the forward orientation FWD along the widthwise direction **9**, the recording head **39** targets the ink to land on the bottom **12**B and discharges the ink D0 second before the carriage **23** reaches the position straight above the bottom **12**B at the reference discharging position Es. In this regard, however, the ink lands on a downstream (rightward) position with respect to the targeted bottom **12**B with regard to the forward orientation FWD (rightward) of the carriage **23** along the widthwise direction **9**, at a landing position LB1. Thus, a distance b1 between the reference discharging position Es and the landing position LB1 along the widthwise direction **9** is greater than a distance b (i.e., D0*V) between the reference discharging position Es and the targeted bottom **12**B along the widthwise direction **9** (distance b1>distance b). A deviated amount between the distance b1 and the distance b is represented by the bottom deviation value Y(m+1).

Therefore, it is necessary that the controller **130** manipulates the recording head **39** to discharge the ink targeted at the bottom **12**B at a bottom-targeted discharging position Eb (see FIG. **9**), which is displaced from the reference discharging position Es downstream with regard to the forward orientation FWD for the amount indicated by the bottom deviation value Y(m+1). Thus, the bottom deviation value Y(m+1) indicates the distance between the reference discharging position Es, at which the recording head **39** should discharge the ink toward the center position **12**C, and the bottom-targeted discharging position Eb, at which the recording head **39** should discharge the ink toward the bottom **12**B, along the widthwise direction **9**. Namely, the bottom deviation value Y(m+1), which specifies the discharging timing for the ink to be discharged to land on the bottom **12**B, is obtained by correctly advancing the discharging timing for the ink to be discharged to at the center position **12**C, which is specified by the reference value D0. In other words, the bottom deviation value Y(m+1), which is obtained by correcting the reference discharging position Es, provides the bottom-targeted discharging position Eb.

[Correction of Discharging Timings by Peak and Bottom Deviation Values]

Therefore, a length of the time required for the carriage **23** to travel the distance corresponding to the peak deviation value Y(m) or the bottom deviation value Y(m+1) is obtained by dividing the peak deviation value Y(m) or the bottom deviation value Y(m+1) by the moving velocity V of the carriage **23**. Namely, the discharging timing targeted at the peak **12**A is expressed as D0+Y(m)/V, and the discharging timing targeted at the bottom **12**B is expressed as D0+Y(m+1)/V. Thus, by shifting the discharging timing targeted at the peak **12**A or the bottom PB from the reference value D0, the ink is discharged to land on the targeted peak **12**A or bottom **12**B. Having mentioned that, however, in the present embodiment, the peak deviation value Y(m) and the bottom deviation value Y(m+1) divided by the moving velocity V are further multiplied by ½, in consideration of results obtained from experiments and simulations, and added to the reference value D0 respectively.

Accordingly, in the recording step A in S**14**, the controller **130** manipulates the recording head **39** to discharge the ink to land on the targeted peaks **12**A at the discharging timings (D0+Y(m)/2V) and the ink to land on the targeted bottoms **12**B at the discharging timings (D0+Y(m+1)/2V). Thus, the discharging timing for the ink to be discharged to land on the targeted peak **12**A (i.e., the peak-targeted discharging position Ea) is specified by the combination of the reference value D0, the peak deviation value Y(m), and the moving velocity V of the carriage **23**. Meanwhile, the discharging timing for the ink to be discharged to land on the targeted bottom **12**B (i.e., the bottom-targeted discharging position Eb) is specified by the combination of the reference value D0, the bottom deviation value Y(m+1), and the moving velocity V of the carriage **23**.

In this regard, values D specifying the discharging timings for the targeted peak **12**A and the targeted bottom **12**B are represented in an expression D=D0+Y(m)/2V and an expression D=D0+Y(m+1)/2V respectively. In this regard, the value D indicates that the ink is to be discharged D second(s) before the carriage **23** reaches the position straight above the targeted position. Therefore, the greater the value D is, the earlier the discharging timing is advanced to be. Meanwhile, the smaller the value D is, the discharging timing is delayed to be later. Accordingly, when the reference value D0 being a positive value is provided, Y(m)/2V being a negative value, of which absolute value is smaller than the reference value D0, and Y(m+1)/2V being a positive value are achieved.

As mentioned above, the sheet **12** is deformed to have eight (8) peaks **12**A and nine (9) bottoms **12**B. Meanwhile, the EEPROM **134** stores the reference value D0, eight peak deviation values Y(2), Y(4), Y(6), Y(8), Y(10), Y(12), Y(14), Y(16), which correspond to one of the eight peaks **12**A respectively, and nine bottom deviation values Y(1), Y(3), Y(5), Y(7), Y(9), Y(11), Y(13), Y(15), Y(17), which correspond to one of the nine bottoms **12**B respectively, therein. Further, the EEPROM **134** stores adjusting values α(1) through (17) and adjusting values β(1) through (17). In the present embodiment, when the peak deviation value for one of the peaks **12**A is represented by a sign Y(m), the bottom deviation value for one of the bottoms **12**B formed on a right-hand side neighboring position with respect to the one of the peaks 12A is represented by a sign Y(m+1). Moreover, both of the peak deviation value for the peak 12A and the bottom deviation value for the bottom 12B on an upstream side of the reference position Ps with regard to the forward orientation FWD are represented by the signs Y(m) and Y(m+1) respectively. Meanwhile, both of the peak deviation value for the peak 12A and the bottom deviation value for the bottom 12B on a downstream side of the reference position Ps with regard to the forward orientation FWD are represented by the signs Y(n) and Y(n+1) respectively.

[Recording Step B (S15)]

The shape of the sheet 12 along the widthwise direction 9 changes depending on the position of tail end in the conveyance flow 16, i.e., before the tail end of the sheet 12 passing through the position A (see the upper row in FIG. 10) and after the tail end of the sheet 12 passing through the position A and in a position between the positions A and B (see the lower row in FIG. 10). In particular, as shown in the lower row in FIG. 10, peaks 12A' and bottoms 12B', excluding the bottom 12B' at the reference position Ps on a dash-and-dot line shown in FIG. 10, are shifted along the widthwise direction 9 to positions displaced from the peaks 12A and the bottoms 12B shown in the upper row in FIG. 10 to be closer to the reference position Ps respectively. In this regard, amounts for the peaks 12A' and the bottoms 12B' to be displaced with respect to the corresponding peaks 12A and the bottoms 12B are enlarged to be larger as the peaks 12A' and the bottoms 12B' are farther from the reference position Ps along the widthwise direction 9. In other words, the peaks 12A' and the bottoms 12B' on the upstream side of the reference position Ps with regard to the forward orientation FWD are displaced to downstream positions with respect to the corresponding peaks 12A and the bottoms 12B respectively, and the farther the peaks 12A' and the bottoms 12B' are apart from the reference position Ps along the widthwise direction, the larger the displaced amounts for the peaks 12A' and the bottoms 12B' are enlarged from the corresponding peaks 12A and the bottoms 12B respectively. Meanwhile, the peaks 12A' and the bottoms 12B' on the downstream side of the reference position Ps with regard to the forward orientation FWD are displaced to upstream positions with respect to the corresponding peaks 12A and the bottoms 12B respectively, and the farther the peaks 12A' and the bottoms 12B' are apart from the reference position Ps along the widthwise direction 9, the larger the displaced amounts for the peaks 12A' and the bottoms 12B' are enlarged from the corresponding peaks 12A and the bottoms 12B respectively.

In this regard, the recording head 39 discharges the ink toward the peak 12A' on the sheet 12 at a corrected peak-targeted discharging position Ea' (see the lower row FIG. 10), which is displaced from the peak-targeted discharging position Ea in a direction to be closer to the reference position Ps, and the recording head 39 discharges the ink toward the bottom 12B' on the sheet 12 at a corrected bottom-targeted discharging position Eb' (see the lower row in FIG. 10), which is displaced from the reference discharging position Eb in the direction to be closer to the reference position Ps. In order to correct the peak-targeted discharging position Ea into the corrected peak-targeted discharging position Ea' and the bottom-targeted discharging position Eb into the corrected bottom-targeted discharging position Eb', an adjusting value α is applied.

The EEPROM 134 stores a plurality of first adjusting values $\alpha(1)$ through $\alpha(17)$, which are used to correct the peak deviation value Y(m) for each peak 12A and the bottom deviation value Y(m+1) for each bottom 12B in the recording step B. In FIG. 12, the deviation values Y and the adjusting value α associated with one another are indicated by same reference numerals placed in parentheses. The first adjusting value α is a value, which affects the peak deviation value Y(m) and the bottom deviation value Y(m+1) to be increased, for a greater amount as the peak 12A' and the bottom 12B' are located in farther positions apart from the reference position Ps toward the upstream side with regard to the forward orientation FWD; and affects the peak deviation value Y(m) and the bottom deviation value Y(m+1) to be decreased, for a greater amount as the peak 12A' and the bottom 12B' are located in farther positions apart from the reference position Ps toward the downstream side with regard to the forward orientation FWD. In particular, with regard to the adjusting values $\alpha(1)$ through $\alpha(8)$, which are values to be applied to the peaks 12A' and the bottoms 12B' formed on the upstream side of the reference position Ps with regard to the forward orientation FWD, the farther the peaks 12A' and bottoms 12B' are apart from the reference position Ps, the greater adjusting values $\alpha(1)$ through $\alpha(8)$ are applied to the peak adjusting values Y(m) and the bottom adjusting values Y(m+1). In this regard, the adjusting values $\alpha(1)$ through $\alpha(8)$ are greater than or equal to zero (0). Meanwhile, with regard to the adjusting values $\alpha(10)$ through $\alpha(17)$, which are values to be applied to the peaks 12A' and the bottoms 12B' formed on the downstream side of the reference position Ps with regard to the forward orientation FWD, the farther the peaks 12A' and bottoms 12B' are apart from the reference position Ps, the smaller adjusting values $\alpha(10)$ through (17) are applied to the peak adjusting values Y(m) and the bottom adjusting values Y(m+1). In this regard, the adjusting values $\alpha(10)$ through $\alpha(17)$ are smaller than or equal to zero (0). Meanwhile, the adjusting value $\alpha(9)$ corresponding to the reference position Ps is zero (0). Largeness or smallness of the adjusting values $\alpha(1)$ through $\alpha(17)$ can be expressed in an inequality: $\alpha(1)\geq\alpha(2)\geq\alpha(3)\geq\alpha(4)\geq\alpha(5)\geq\alpha(6)\geq\alpha(7)\geq\alpha(8)\geq\alpha(9)\geq\alpha(10)\geq\alpha(11)\geq\alpha(12)\geq\alpha(13)\geq\alpha(14)\geq\alpha(15)\geq\alpha(16)\geq\alpha(17)$. In the present embodiment, the adjusting values α, which are used to adjust the peak deviation values (Y) and the bottom deviation values Y(m+1) for the peaks 12A' and the bottoms 12B' formed on the upstream side of the reference position Ps with regard to the forward orientation FWD may be represented by $\alpha(m)$; and the adjusting values α, which are used to adjust the peak deviation values (Y) and the bottom deviation values Y(n+1) for the peaks 12A' and the bottoms 12B' formed on the downstream side of the reference position Ps with regard to the forward orientation FWD may be represented by $\alpha(n)$.

Thus, the discharging timings for the recording head 39 to discharge the ink in the recording step B in S15 are obtained by adjusting the peak deviation values Y(m) and the bottom deviation values Y(m+1), which are adjusted by applying the adjusting value α and deviating the adjusted peak deviation values Y(m) and the bottom deviation values Y(m+1), from the reference value D0 respectively. In particular, the peak deviation values Y(m) and the bottom deviation values Y(m+1) are adjusted by adding the adjusting values α. Therefore, in the recording step B in S15, the discharging timings are obtained by dividing the adjusted peak deviation values Y(m) and the adjusted bottom deviation values Y(m+1) by the moving velocity V of the carriage 39, multiplying the divided quotient by ½, and adding the multiplied value to the reference value D0.

Thus, in the recording step B in S15, the discharging timings to discharge the ink toward the peaks 12A' formed on the upstream side of the reference position Ps with regard to the forward orientation FWD, i.e., the corrected peak-targeted discharging positions Ea', are expressed as $D0+(Y(m)+\alpha(m))/2V$; and the discharging timings to discharge the ink toward the bottoms **12**B' formed on the upstream side of the reference position Ps with regard to the forward orientation FWD, i.e., the corrected bottom-targeted discharging positions Eb', are expressed as D0+(Y(m+1)+α(m+1))/2V. Meanwhile, the discharging timings to discharge the ink toward the peaks **12**A' formed on the downstream side of the reference position Ps with regard to the forward orientation FWD, i.e., the corrected peak-targeted discharging positions Ea', are expressed as D0+(Y(n)+α(n))/2V; and the discharging timings to discharge the ink toward the bottoms **12**B' formed on the downstream side of the reference position Ps with regard to the forward orientation FWD, i.e., the corrected bottom-targeted discharging positions Eb', are expressed as D0+(Y(n+1)+α(n+1))/2V.

Therefore, the controller **130** manipulates the recording head **39** to discharge the ink toward the peaks **12**A' formed on the upstream side of the reference position Ps with regard to the forward orientation FWD at the discharging timings D0+(Y(m)+α(m))/2V, and toward the bottoms **12**B' formed on the upstream side of the reference position Ps with regard to the forward orientation FWD at the discharging timings D0+(Y(m+1)+α(m+1))/2V. Meanwhile, the controller **130** manipulates the recording head **39** to discharge the ink toward the peaks **12**A' formed on the downstream side of the reference position Ps with regard to the forward orientation FWD at the discharging timings D0+(Y(n)+α(n))/2V, and toward the bottoms **12**B' formed on the downstream side of the reference position Ps with regard to the forward orientation FWD at the discharging timings D0+(Y(n+1)+α(n+1))/2V. Thus, in the recording step B in S**15**, as shown in FIG. **10**, the inks targeted at the positions on the upstream side of the reference position Ps with regard to the forward orientation FWD are discharged in delayed discharging timings compared to the discharging timings in the recording step A in S**14**, and the inks targeted at the positions on the downstream side of the reference position Ps with regard to the forward orientation FWD are discharged in advanced discharging timings compared to the discharging timings in the recording step A in S**14**.

Thus, the expressions D0+(Y(m)+α(m))/2V, D0+(Y(m+1)+α(m+1))/2V, D0+(Y(n)+α(n))/2V, and D0+(Y(n+1)+α(n+1))/2V represent the discharging timings in the recording step B in S**15**. The reference value D0; the peak deviation values Y(m), Y(n); the adjusting values α(m), α(n); and the moving velocity V of the carriage **39** are used to obtain the discharging timings (i.e., the corrected peak-targeted discharging positions Ea') to discharge the ink so that the ink should land on the peaks **12**A'. The reference value D0; the peak deviation values Y(m+1), Y(n+1); the adjusting values α(m+1), α(n+1); and the moving velocity V of the carriage **39** are used to obtain the discharging timings (i.e., the corrected bottom-targeted discharging positions Eb') to discharge the ink so that the ink should land on the bottoms **12**B'.

[Recording Step C (S**16**)]

The shape of the sheet **12** along the widthwise direction **9** changes depending on the position of tail end in the conveyance flow **16**, i.e., before the tail end of the sheet **12** passing through the position A (see the upper row in FIG. **11**) and after the tail end of the sheet **12** passing through the position B (see the lower row in FIG. **11**). In particular, as shown in the lower row in FIG. **11**, peaks **12**A" and bottoms **12**B", excluding the bottom **12**B" at the reference position Ps on a dash-and-dot line shown in FIG. **11**, are shifted along the widthwise direction **9** to positions displaced to be away from the peaks **12**A and the bottoms **12**B shown in the upper row in FIG. **11** respectively. In this regard, amounts for the peaks **12**A" and the bottoms **12**B" to be displaced with respect to the corresponding peaks **12**A and the bottoms **12**B are enlarged to be greater as the peaks **12**A" and the bottoms **12**B" are farther from the reference position Ps. In other words, the peaks **12**A" and the bottoms **12**B" on the upstream side of the reference position Ps with regard to the forward orientation FWD are displaced to the farther upstream positions with respect to the corresponding peaks **12**A and the bottoms **12**B respectively, and the farther the peaks **12**A" and the bottoms **12**B" are apart from the reference position Ps, the larger the displaced amounts for the peaks **12**A" and the bottoms **12**B" are enlarged from the corresponding peaks **12**A and the bottoms **12**B respectively. Meanwhile, the peaks **12**A" and the bottoms **12**B" on the downstream side of the reference position Ps with regard to the forward orientation FWD are displaced to the farther downstream positions with respect to the corresponding peaks **12**A and the bottoms **12**B respectively, and the farther the peaks **12**A" and the bottoms **12**B" are apart from the reference position Ps, the larger the displaced amounts for the peaks **12**A" and the bottoms **12**B" are enlarged from the corresponding peaks **12**A and the bottoms **12**B respectively.

In this regard, the recording head **39** discharges the ink toward the peak **12**A" on the sheet **12** at a corrected peak-targeted discharging position Ea" (see the lower row FIG. **11**), which is displaced from the peak-targeted discharging position Ea in a direction to be farther from the reference position Ps, and the recording head **39** discharges the ink toward the bottom **12**B" on the sheet **12** at a corrected bottom-targeted discharging position Eb" (see the lower row in FIG. **11**), which is displaced from the bottom-targeted discharging position Eb in the direction to be farther from the reference position Ps. In order to correct the peak-targeted discharging position Ea into the corrected peak-targeted discharging position Ea" and the bottom-targeted discharging position Eb into the corrected bottom-targeted discharging position Eb", an adjusting value β is applied.

The EEPROM **134** stores a plurality of adjusting values β(1) through β(17), which are used to correct the peak deviation value Y(m) for each peak **12**A and the bottom deviation value Y(m+1) for each bottom **12**B in the recording step C. In FIG. **12**, the deviation values Y and the adjusting value β associated with one another are indicated by same reference numerals placed in parentheses. The adjusting value β is a value, which affects the peak deviation value Y(m) and the bottom deviation value Y(m+1) to be decreased, for a greater amount as the peak **12**A" and the bottom **12**B" are located in farther positions apart from the reference position Ps toward the upstream side with regard to the forward orientation FWD; and affects the peak deviation value Y(m) and the bottom deviation value Y(m+1) to be increased, for a greater amount as the peak **12**A" and the bottom **12**B" are located in farther positions apart from the reference position Ps toward the downstream side with regard to the forward orientation FWD. In particular, with regard to the adjusting values β(1) through β(8), which are values to be applied to the peaks **12**A" and the bottoms **12**B" formed on the upstream side of the reference position Ps with regard to the forward orientation FWD, the farther the peaks **12**A" and bottoms **12**B" are apart from the reference position Ps, the smaller adjusting values β(1) through β(8) are applied to the peak adjusting values Y(m) and the bottom adjusting values Y(m+1). In this regard, the adjusting values β(1) through β(8) are smaller than or equal to zero (0). Meanwhile, with regard to the adjusting values β(10) through β(17), which are values to be applied to the peaks **12**A" and the bottoms **12**B" formed on the downstream side of the reference position Ps with regard to the forward orientation FWD, the farther the peaks **12**A" and bottoms **12**B" are apart from the reference position Ps, the greater adjusting values $\beta(10)$ through $\beta(17)$ are applied to the peak adjusting values Y(m) and the bottom adjusting values Y(m+1). In this regard, the adjusting values $\beta(10)$-through $\beta(17)$ are greater than or equal to zero (0). Meanwhile, the adjusting value $\beta(9)$ corresponding to the reference position Ps is zero (0). Largeness or smallness of the adjusting values $\beta(1)$ through $\beta(17)$ can be expressed in an inequality: $\beta(1)\leq\beta(2)\leq\beta(3)\leq\beta(4)\leq\beta(5)\leq\beta(6)\leq\beta(7)\leq\beta(8)\leq\beta(9)\leq\beta(10)\leq\beta(11)\leq\beta(12)\leq\beta(13)\leq\beta(14)\leq\beta(15)\leq\beta(16)\leq\beta(17)$. In the present embodiment, the adjusting values β, which are used to adjust the peak deviation values (Y) and the bottom deviation values Y(m+1) for the peaks **12**A" and the bottoms **12**B" formed on the upstream side of the reference position Ps with regard to the forward orientation FWD may be represented by $\beta(m)$; and the adjusting values β, which are used to adjust the peak deviation values (Y) and the bottom deviation values Y(n+1) for the peaks **12**A" and the bottoms **12**B" formed on the downstream side of the reference position Ps with regard to the forward orientation FWD may be represented by $\beta(n)$.

The discharging timings for the recording head **39** to discharge the ink in the recording step C in S**16** are obtained by adjusting the peak deviation values Y(m) and the bottom deviation values Y(m+1), which are adjusted by applying the adjusting value β and deviating the adjusted peak deviation values Y(m) and the bottom deviation values Y(m+1) from the reference value D0 respectively. In particular, the peak deviation values Y(m) and the bottom deviation values Y(m+1) are adjusted by adding the adjusting values β. Therefore, in the recording step C in S**16**, the discharging timings are obtained by dividing the adjusted peak deviation values Y(m) and the adjusted bottom deviation values Y(m+1) by the moving velocity V of the carriage **39**, multiplying the divided quotient by ½, and adding the multiplied value to the reference value D0.

Thus, in the recording step C in S**16**, the discharging timings to discharge the ink toward the peaks **12**A" formed on the upstream side of the reference position Ps with regard to the forward orientation FWD, i.e., the corrected peak-targeted discharging positions Ea", are expressed as $D0+(Y(m)+\beta(m))/2V$; and the discharging timings to discharge the ink toward the bottoms **12**B" formed on the upstream side of the reference position Ps with regard to the forward orientation FWD, i.e., the corrected bottom-targeted discharging positions Eb", are expressed as $D0+(Y(m+1)+\beta(m+1))/2V$. Meanwhile, the discharging timings to discharge the ink toward the peaks **12**A" formed on the downstream side of the reference position Ps with regard to the forward orientation FWD, i.e., the corrected peak-targeted discharging positions Ea", are expressed as $D0+(Y(n)+\beta(n))/2V$; and the discharging timings to discharge the ink toward the bottoms **12**B" formed on the downstream side of the reference position Ps with regard to the forward orientation FWD, i.e., the corrected bottom-targeted discharging positions Eb", are expressed as $D0+(Y(n+1)+\beta(n+1))/2V$.

Therefore, the controller **130** manipulates the recording head **39** to discharge the ink toward the peaks **12**A" formed on the upstream side of the reference position Ps with regard to the forward orientation FWD at the discharging timings $D0+(Y(m)+\beta(m))/2V$, and toward the bottoms **12**B" formed on the upstream side of the reference position Ps with regard to the forward orientation FWD at the discharging timings $D0+(Y(m+1)+\beta(m+1))/2V$. Meanwhile, the controller **130** manipulates the recording head **39** to discharge the ink toward the peaks **12**A" formed on the downstream side of the reference position Ps with regard to the forward orientation FWD at the discharging timings $D0+(Y(n)+\beta(n))/2V$, and toward the bottoms **12**B" formed on the downstream side of the reference position Ps with regard to the forward orientation FWD at the discharging timings $D0+(Y(n+1)+\beta(n+1))/2V$. Thus, in the recording step C in S**16**, as shown in FIG. **11**, the inks targeted at the positions on the upstream side of the reference position Ps with regard to the forward orientation FWD are discharged in advanced discharging timings compared to the discharging timings in the recording step A in S**14**, and the inks targeted at the positions on the downstream side of the reference position Ps with regard to the forward orientation FWD are discharged in delayed discharging timings compared to the discharging timings in the recording step A in S**14**.

Thus, the expressions $D0+(Y(m)+\beta(m))/2V$, $D0+(Y(m+1)+\beta(m+1))/2V$, $D0+(Y(n)+\beta(n))/2V$, and $D0+(Y(n+1)+\beta(n+1))/2V$ represent the discharging timings in the recording step C in S**16**. The reference value D0; the peak deviation values Y(m), Y(n); the adjusting values $\beta(m)$; and the moving velocity V of the carriage **39** are used to obtain the discharging timings (i.e., the corrected peak-targeted discharging positions Ea") to discharge the ink so that the ink should land on the peaks **12**A". The reference value D0; the peak deviation values Y(m+1), Y(n+1); the adjusting values $\beta(m+1)$; and the moving velocity V of the carriage **39** are used to obtain the discharging timings (i.e., the corrected bottom-targeted discharging positions Eb") to discharge the ink so that the ink should land on the bottoms **12**B".

In the following description, the discharging timings to discharge the ink toward the sheet **12** in the recording step A (S**14**) may be referred to as first discharging timings. The discharging timings to discharge the ink toward the sheet **12** in the recording step C (S**16**) may be referred to as second discharging timings, while the discharging timings to discharge the ink toward the sheet **12** in the recording step B (S**15**) may be referred to as third discharging timings.

[Discharging Timings for Transitional Positions]

In the recording step A in S**14**, meanwhile, the controller **130** calculates the first discharging timings to discharge the ink at transitional positions between each peak **12**A and bottom **12**B and manipulates the recording head **39** to discharge the ink toward the transitional positions at the calculated first discharging timings. The first discharging timings for the transitional positions are obtained based on the peak deviation value Y(m), which is a peak deviation value Y(m) for one of the peaks **12**A closest to the transitional position along the widthwise direction **9**, and the bottom deviation value Y(m+1), which is a bottom deviation value Y(m+1) for one of the bottoms **12**B closest to the transitional position along the widthwise direction **9**. Further, an interpolating expression 1 described below and the reference value D0 are used for the calculation.

More specifically, the controller **130** fills the interpolating expression 1 with values (x, c) which identify the transitional position, the peak deviation value Y(m) of the peak **12**A closest to the transitional position, and the bottom deviation value Y(m+1) of the bottom **12**B closest to the transitional position. Thereby, a deviation value y', which indicates a deviated amount between the targeted transitional position and a landing position for the ink discharged D0 second(s) before the carriage **23** reaches a position straight above the targeted transitional position along the widthwise direction **9**, is calculated. Thereafter, the controller **130** fills expression 2 described below with the deviation value y' and the reference value D0. Thus, the discharging timing to discharge the ink toward the targeted transitional position is obtained. The controller **130** repeats the calculations for all the transitional positions in between each peak **12**A and bottom **12**B.

[Expression 1]

$$y' = -\frac{1}{L^3}(Y_{(m+1)} - Y_{(m)})(x + c - X_{(m)})^2\{2(x + c - X_{(m)}) - 3L\} + Y_{(m)}$$

[Expression 2]

$$D_{(x)} = \frac{y'}{2V} + D_0$$

The value x in the expression 1 identifies a position of the carriage **23** and is determined based on the pulse signals from the linear encoder **180**. The value c in the expression 1 indicates a distance between the nozzle **40**, of which discharging timing is being calculated, and a widthwise center of the recording head **39**. The value X(m) in the expression 1 indicates the positions of the peak **12**A and the bottom **12**B closest to the transitional position and is determined based on the pulse signals from the linear encoder **180**. The value L in the expression 1 indicates a distance between the peak **12**A and the bottom **12**B closest to the transitional position and is expressed as L=X(m+1)−X(m). The value V in the expression 2 indicates the moving velocity of the carriage **23**.

In the recording step B in S**15**, meanwhile, the controller **130** fills the interpolating expression with the adjusted peak deviation values (Y(m)+α(m)) instead of the peak deviation values Y(m) and the adjusted bottom deviation values (Y(m+1)+α(m+1)) instead of the bottom deviation values Y(m+1) respectively to obtain the third discharging timings for the transitional positions. Thus, the controller **130** manipulates the recording head **39** to discharge the ink toward transitional positions in the sheet P at the calculated third discharging timings. In the recording step C in S**16**, on the other hand, the controller **130** fills the interpolating expression with the adjusted peak deviation values (Y(m)+β(m)) instead of the peak deviation values Y(m) and the adjusted bottom deviation values (Y(m+1)+β(m+1)) instead of the bottom deviation values Y(m+1) respectively to obtain the second discharging timings for the transitional positions. Thus, the controller **130** manipulates the recording head **39** to discharge the ink toward transitional positions in the sheet P at the calculated second discharging timings.

Next, in the image recording operation, in S**17** (see FIG. **8**), if an entire image for the image recording instruction is not completely recorded on the sheet (S**17**: NO) **12**, in S**18**, the controller **130** transitively conveys the sheet **12** along the conveyance flow **16** for a predetermined linefeed amount. In particular, the controller **130** manipulates the conveyer motor **102** to rotate for a predetermined amount so that at least one of the conveyer roller unit **54** and the ejection roller unit **55** is driven to convey the sheet **12** for the predetermined linefeed amount. Accordingly, a next recordable range in the sheet **12** is placed to face the recording head **39**.

Following S**17**, the controller **130** repeats S**12**-S**18** until the entire image is completely recorded on the sheet **12**. When the entire image is completely recorded on the sheet **12** (S**17**: YES), in S**19**, the controller **130** controls the rotation of the rollers so that sheet **12** is ejected in the dejection tray **21**. In particular, the controller **130** manipulates the conveyer motor **102** to rotate for a predetermined amount. Thus, the sheet **12** is conveyed to the ejection tray **21** by the ejection roller unit **55** and ejected from the MFD **10**.

[Usability of the Embodiment]

According to the embodiment described above, one of the recording steps A, B, C, in which the discharging timings are different from one another depending on the position of the sheet **12** in the conveyance flow **16** (i.e., the shape of the sheet **12** in the widthwise direction **9**), is conducted. Therefore, while the sheet **12** is in a contracted condition in the widthwise direction **9**, i.e., in the shape shown in the lower row in FIG. **10**, the discharging timings to discharge the ink toward the upstream side of the reference position Ps on the sheet **12** with regard to the forward orientation FWD are delayed, and the discharging timings to discharge the ink toward the downstream side of the reference position Ps on the sheet **12** with regard to the forward orientation FWD are advanced. On the other hand, while the sheet **12** is in a stretched condition in the widthwise direction **9**, i.e., in the shape shown in the lower row in FIG. **11**, the discharging timings to discharge the ink toward the upstream side of the reference position Ps on the sheet **12** with regard to the forward orientation FWD are advanced, and the discharging timings to discharge the ink toward the downstream side of the reference position Ps on the sheet **12** with regard to the forward orientation FWD are delayed. Thus, the deviation of the ink on the sheet **12** from the targeted positions can be restrained throughout the width of the sheet **12**.

According to the embodiment described above, the discharging timings are modified after the tail end of the sheet **12** passes through the position A and further modified after the tail end of the sheet **12** passes through the position B. However, it is noted that the tail end of the sheet **12** may not necessarily stop at the position between the position A and the position B; therefore, for example, the recording step B may be omitted. In other words, the controller **130** may conduct the recording step A until the tail end of the sheet **12** passes through the position B and conducts the recording step C after the tail end of the sheet **12** passes through the position B.

Further, the discharging timings may be modified after a leading end of the sheet **12** passes through the corrugating spurs **68**. The leading end of the sheet **12** refers to a downstream end of the sheet **12** being conveyed with regard to the direction of the conveying flow **16**. For example, the controller **130** may conduct the recording step C until the leading end of the sheet **12** passes through the corrugating spurs **68** and conducts the recording step A after the leading end of the sheet **12** passes through the corrugating spurs **68**. The control in this example may be performed in addition to or independently from the image recording operation shown in FIG. **8**. In other words, this exemplary control may be performed in an MFD **10**, which is not equipped with the contact pieces **80**.

According to the embodiment described above, the discharging timings for other targeted positions which is, for example, the targeted positions for the transient positions between the peaks **12**A and the bottoms **12**B, are calculated by filling the interpolating expression with the peak deviation values Y(m) and the bottom deviation values Y(m+1); therefore, it is not necessary to store peak and bottom deviation values for each one of innumerably existing transitional positions in the EEPROM **134**. Thus, a memory size for the EEPROM **134** may be maintained smaller. Further, while the discharging timings for the transitional positions are calculated based on the adjusted peak deviation values adjusted by the adjusting values α and β, the ink can be discharged in the adjusted preferable discharge timings.

In the embodiment described above, it has been described that the reference value D0 is a parameter representing the reference timing, and the peak deviation value Y(m) and the bottom deviation value Y(m+1) are parameters representing the deviated distances. However, the parameters for the adjustment may not necessarily be limited to those, but other parameters which can specify the discharging timings may arbitrarily be used. For example, the reference value D0, the peak deviation value Y(m), and the bottom deviation value Y(m+1) may be expressed by timings or in distances uniformly.

According to the embodiment described above, the position of the bottom **12**B at the widthwise center along the widthwise direction **9** is defined as the reference position Ps; however, the reference position Ps may not necessarily be coincident with the position of the bottom **12**B at the widthwise center. For example, a position of a widthwise center of the sheet **12** in the widthwise direction **9** may be defined as the reference position Ps. For another example, a position of one of widthwise ends of the platen **42** in the widthwise direction **9** may be defined as the reference position Ps. Further, the sheet **12** may not necessarily be center-aligned at the widthwise center of the bottom panel **91** in the feeder tray **20** but may be placed to align with a widthwise end in the feeder tray **20**.

Although an example of carrying out the invention has been described, those skilled in the art will appreciate that there are numerous variations and permutations of the inkjet printer that fall within the spirit and scope of the invention as set forth in the appended claims. It is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or act described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims.

More Examples

With reference to FIGS. **13**A-**13**D, processes, in which the third and second discharging timings to be used in the recording steps B, C are further modified, will be described. The flows shown in FIGS. **13**A-**13**D may be used, when specific conditions are met, to modify the second and third discharging timings from the first discharging timings for larger extent than the extent to adjust the first discharging timings when the specific conditions are not met. In this regard, a method to modify the second and third discharging timings for the larger extent may not necessarily be limited. For example, the second and third discharging timings may be adjusted for the larger extent by increasing absolute values in the adjusting values α, β.

With reference to FIG. **13**A, a flow to modify the second and third discharging timings depending on a type of the sheet **12** will be described. The flow shown in FIG. **13**A is based on an assumption that a dimension of a less rigid sheet **12** in the widthwise direction **9** tends to change for a larger amount along the widthwise direction **9** as the tail end of the sheet **12** passes through the position A and the position B compared to a rigid sheet **12**.

As the flow starts, in S**31**, the controller **130** judges a type of the sheet **12**. If the sheet **12** is a regular sheet of paper (S**31**: YES), in S**32**, the controller **130** increases the absolute values in the adjusting values α, β. On the other hand, if the sheet **12** is a glossy sheet (S**31**: NO), the controller **130** does not change the absolute values in the adjusting values α, β. The judgment in S**31** may be made, for example, based on information indicating the type of the sheet **12**, which may be included in the image recording instruction. In the flow shown in FIG. **13**A, the discharging timings are modified depending on the type of the sheet **12**. However, the type of the sheet **12** may not necessarily be limited to the regular sheet and the glossy sheet. In other words, in S**32**, the absolute values in the adjusting values α, β may be increased when rigidity of the sheet **12** is lower than a predetermined threshold.

Next, with reference to FIG. **13**B, a flow to modify the second and third discharging timings depending on an aligning direction of fiber in the sheet **12** will be described. When the sheet **12** is conveyed in a parallel state that the fiber alignment thereof is parallel to the conveyance flow **16**, the sheet **12** tends to change for a larger amount along the widthwise direction **9** as the tail end of the sheet **12** passes through the position A and the position B compared to when the sheet **12** is conveyed in a no-parallel state that the fiber alignment thereof is cross to the conveyance flow **16** (in other words, the fiber alignment thereof is parallel to the widthwise direction **8**).

Therefore, as the flow starts, in S**41**, the controller **130** judges alignment of the fiber in the sheet **12**. If the sheet **12** is in the parallel state (S**41**: YES), in S**42**, the controller **130** increases the absolute values in the adjusting values α, β. On the other hand, if the sheet **12** is in the non-parallel state (S**41**: NO), the controller **130** does not change the absolute values in the adjusting values α, β. The judgment in S**41** may be made, for example, based on information indicating the fiber alignment in the sheet **12** (i.e., information concerning a size and/or arrangement of the sheet **12**), which may be included in the image recording instruction.

Next, with reference to FIG. **13**C, a flow to modify the second and third discharging timings depending on ambient temperature around the MFD **10** will be described. The flow shown in FIG. **13**C is based on an assumption that the dimension of the sheet **12** in the widthwise direction **9** tends to change for a larger amount along the widthwise direction **9** when the ambient temperature is higher compared to the amount of the widthwise dimension to change in lower ambient temperature as the tail end of the sheet **12** passes through the position A and the position B.

Therefore, as the flow starts, in S**51**, the controller **130** judges the ambient temperature. If the ambient temperature is higher than a predetermined threshold (S**51**: YES), in S**52**, the controller **130** increases the absolute values in the adjusting values α, β. On the other hand, if the ambient temperature is lower than or equal to the predetermined threshold (S**51**: NO), the controller **130** does not change the absolute values in the adjusting values α, β. The MFD **10** in this example is equipped with a temperature sensor (not shown), which measures the temperature of the ambient air and notifies the controller **130** of the measured result. The judgment in S**51** may be made, therefore, based on comparison of the measured temperature of the ambient air with the predetermined threshold. A location of the temperature sensor is not necessarily limited.

Next, with reference to FIG. **13**D, a flow to modify the second and third discharging timings depending on ambient humidity around the MFD **10** will be described. The flow shown in FIG. **13**D is based on an assumption that the dimension of the sheet **12** in the widthwise direction **9** tends to change for a larger amount along the widthwise direction **9** when the ambient humidity is higher compared to the amount of the widthwise dimension to change in lower ambient humidity as the tail end of the sheet **12** passes through the position A and the position B.

Therefore, as the flow starts, in S**61**, the controller **130** judges the ambient humidity. If the ambient humidity is higher than a predetermined degree of humidity (S**61**: YES), in S**62**, the controller **130** increases the absolute values in the adjusting values α, β. On the other hand, if the ambient humidity is lower or equal to the predetermined degree of humidity (S**61**: NO), the controller **130** does not change the absolute values in the adjusting values α, β. The MFD **10** in this example is equipped with a humidity sensor (not shown), which measures the humidity of the ambient air and notifies the controller **130** of the measured result. The judgment in

S61 may be made, therefore, based on comparison of the measured humidity of the ambient air with the predetermined threshold. A location of the humidity sensor is not necessarily limited.

Each of the modifying flows shown in FIGS. **13**A-**13**D may be performed alone or in combination with one another in between, for example, S**12** and S**13** (see FIG. **8**). With the modifying flows, the ink may be discharged at the sheet **12** in even more preferable discharging timings according to the condition of the sheet **12**.

In the present embodiment, the adjusting values $\alpha(1)$ through $\alpha(17)$ and $\beta(1)$ through $\beta(17)$ are stored in the EEPROM **134**; however, the adjusting values $\alpha(1)$ through $\alpha(17)$ or $\beta(1)$ through $\beta(17)$ may not necessarily be stored in the EEPROM **134**. For example, the controller **130** may be equipped with a calculating means to calculate a linear equation $Y'=Y+(X(m)-X(c))C$. The calculating means may be, for example, achieved by the controller **130** executing a software program or by a hardware circuits cooperating with the software program. In other words, the controller **130** may adjust the values Y, i.e., Y(m) and Y(m+1), by the above-mentioned linear equation expressed by Y'.

It is noted that the value Y mentioned above represents the deviation values including the peak deviation values Y(m) and the bottom deviation values Y(m+1). The values X(m) represent values, which identify the positions of the peaks **12**A and the bottoms **12**B and are determined based on the pulse signals from the linear encoder **180**. The value X(c) represents a position of the bottom **12**B, which is at the widthwise center on the widthwise direction **9**, among the plurality of bottoms **12**B. In other words, the value X(c) represents a position of the supporting rib **52**, which is at the widthwise center on the widthwise direction **9**, among the plurality of supporting ribs **52**. These values X(m) and X(c) may be stored in the ROM **131** or in the EEPROM **134**. The value C represents an inclination of the linear equation represented by Y'. The inclination C may vary in each MFD **10** and is stored in the EEPROM **134**.

For example, in order to adjust the peak deviation value Y(2), the controller **130** obtains the peak deviation value Y(2) and the inclination C from the EEPROM **134** and the value X(2) and X(c) from the ROM **131** or the EEPROM **134**. The controller **130** fills the linear equation with the obtained Y(2), C, X(2), and X(c) to calculate Y'(2). In this regard, if, for example, the recording head **39** on the carriage **23** moving in the forward orientation FWD discharges the ink at the position X(2), i.e., a position above the peak **12**A(**2**), the discharged ink lands on a downstream position with respect to the peak **12**A(**2**) with regard to the forward orientation FWD. Therefore, it is necessary that the controller **130** calculates the value Y'(2) so that the ink should be discharged from the recording head **39** on the carriage **23** moving in the forward orientation FWD in an upstream position with respect to the position X(2) for a predetermined distance. Thus, when the recording head **39** discharges the ink at the discharging timing indicated by Y'(2), the discharged ink lands on the peak **12**A (**2**). The controller **130** may obtain the value Y' for each point before the carriage **23** starts moving in the forward orientation FWD.

For another example, the value C representing the inclination of the linear equation may include two or more different values C1, C2, etc. For example, inclination C1 may be used when the tail end of the sheet **12** is on a downstream side of the position A and on an upstream side of the position B with regard to the conveyance direction **16** (S**13**: A<tail end≤B in the flow shown in FIG. **8**). In other words, when the tail end of the sheet **12** is in a position between the position A and the position B, the controller **130** may read the value C1 from the EEPROM **134** and adjust Y. In the meantime, inclination C2 may be used when the tail end of the sheet **12** is on a downstream side of the position B with regard to the conveyance flow **16** (S**13**: B<tail end in the flow shown in FIG. **8**). In other words, when the tail end of the sheet **12** is on the downstream side of the position B, the controller **130** may read the value C2 and adjust Y. In this regard, C1 is smaller than C2 (C1<C2), and, according to the embodiment described above, C1 is a negative constant and C2 is appositive constant.

What is claimed is:

1. An inkjet printer comprising:

a conveyer configured to convey a sheet along a conveyance direction;

a recording head configured to discharge ink toward the sheet being conveyed by the conveyer;

a carriage mounting the recording head thereon and being configured to move along a scanning direction;

a corrugation mechanism configured to shape into a corrugated shape, in which an amount of a gap between the recording head and the sheet is increased and decreased alternately along the scanning direction, at a corrugating position; and

a controller configured to execute an operation comprising:

a conveying step, in which the sheet is conveyed by the conveyer; and

a recording step, in which the carriage is moved in the scanning direction and the recording head is manipulated to discharge the ink toward the sheet,

wherein the recording step comprises:

a first discharging step, in which, after the conveying step and on condition that the sheet is present at the corrugating position, the recording head is manipulated to discharge the ink toward a targeted position on the sheet along the scanning direction at a first discharging timing; and

a second discharging step, in which, after the conveying step and on condition that the sheet is absent at the corrugating position, the recording head is manipulated to discharge the ink toward the targeted position on the sheet along the scanning direction at a second discharging timing which is deviated from the first discharging timing, the farther the targeted position being separated from a reference position on the sheet along the scanning direction, the more largely the second discharging timing being deviated from the first discharging timing.

2. The inkjet printer according to claim **1**,

wherein, in the second discharging step, the ink targeted at the targeted position on an upstream side of the reference position in a moving orientation of the carriage is discharged at the second discharging timing, which is advanced to be earlier than the first discharging timing; and

wherein, in the second discharging step, the ink targeted the targeted position on a downstream side of the reference position in the moving orientation is discharged at the second discharging timing, which is delayed to be later than the first discharging timing.

3. The inkjet printer according to claim **2**,

wherein the conveyer comprises:

a conveyer roller unit, the conveyer roller unit being disposed on an upstream side of the carriage in the conveyance direction and being configured to nip the sheet and convey the sheet along the conveyance direction; and wherein the corrugating position is between the conveyer roller unit and the recording head;

wherein the operation to be executed by the controller further comprise a detecting step, in which a position of a tail end of the sheet is detected;

wherein, in the recording step, while the position of the tail end of the sheet detected indicates that the tail end has not passed through the conveyer roller unit, the controller executes the first discharging step; and

wherein, in the recording step, while the position of the tail end of the sheet detected indicates that the tail end has passed through the corrugating position, the controller executes the second discharging step.

4. The inkjet printer according to claim 3,

wherein the recording step further comprises a third discharging step executed after the conveying step and on condition that the position of the tail of the sheet detected indicates that the tail end has passed through the conveyer roller unit but has not passed through the corrugating position, and in the third discharging step, the recording head is manipulated to discharge the ink toward the targeted position on the sheet along the scanning direction at a second discharging timing which is deviated from the first discharging timing,

wherein, in the third discharging step, the ink targeted at the targeted position on the upstream side of the reference position in the moving orientation is discharged at a third discharging timing, which is delayed to be later than the first discharging timing;

wherein, in the third discharging step, the ink targeted at the targeted position on the downstream side of the reference position in the moving orientation is discharged at the third discharging timing, which is advanced to be earlier than the first discharging timing.

5. The inkjet printer according to claim 4,

wherein the corrugation mechanism is configured to shape the sheet into the corrugated shape having a plurality of protrusive points, at which tendency of the amount of the gap between the recording head and the sheet turns from decreasing to increasing, and a plurality of recessed points, at which tendency of the amount of the gap turns from increasing to decreasing, the protrusive points and the recessed points being formed alternately along the scanning direction:

wherein the target position toward which the ink is discharged includes a plurality of targeted positions on the protrusive points and the recessed points;

wherein, in the second discharging step and in the third discharging step, the recording head is manipulated to discharged the ink toward the targeted positions on the protrusive and the recessed points at a second discharging timing and third discharged timing which are deviated from the first discharging timing, the farther targeted positions being separated from the reference position on the sheet along the scanning direction, the more largely both the second discharging timing and third discharging timing being deviated from the first discharging timing.

6. The inkjet printer according to claim 5, further comprising:

a memory device configured to store:

a reference value indicating a reference discharging timing;

a plurality of protrusion deviation values used to delay the first discharging timing for the protrusive points from the reference discharging timing;

a plurality of recess deviation values used to advance the first discharging timing for the recessed points from the reference discharging timing; and

a plurality of first adjusting values and a plurality of second adjusting values used to adjust the protrusion deviation values and the recess deviation values;

wherein the farther targeted positions on the protrusive points and the recessed points are separated from the reference position toward the upstream side in the moving orientation of carriage, the more largely the first adjusting values decrease the protrusion deviation values and the recess deviation values; and the farther the targeted positions on the protrusive points and the recessed points are separated from the reference position toward the downstream side in the moving orientation of carriage, the more largely the first adjusting values increase the protrusion deviation values and the recess deviation values;

wherein the farther targeted positions on the protrusive points and the recessed points are separated from the reference position toward the upstream side of the reference position in the moving orientation of the carriage, the more largely the second adjusting values increase the protrusion deviation values and the recess deviation values; and the farther the targeted positions on the protrusive points and the recessed points are separated from the reference position toward the downstream side of the reference position in the moving orientation of the carriage, the more largely the second adjusting values decrease the protrusion deviation values and the recess deviation values;

wherein, in the first discharging step, the controller manipulates the recording head to discharge the ink toward the targeted positions on the protrusive points and the recessed points at the first discharging timings, which are deviated from the reference value for lengths corresponding to the protrusion deviation values and the recess deviation values;

wherein, in the second discharging step, the controller manipulates the recording head to discharge the ink toward the targeted positions on the protrusive points and the recessed points at the second discharging timings, which are deviated from the reference value for lengths corresponding to the protrusion deviation values adjusted by the first adjusting values and the recess deviation values adjusted by the first adjusting values; and

wherein, in the third discharging step, the controller manipulates the recording head to discharge the ink toward the targeted positions on the protrusive points and the recessed points at the third discharging timings, which are deviated from the reference value for lengths corresponding to the protrusion deviation values adjusted by the second adjusting values and the recess deviation values adjusted by the second adjusting values.

7. The inkjet printer according to claim 6,

wherein, the farther the targeted positions on the protrusive points and the recessed points on the upstream side of the reference position in the moving orientation are separated from the reference position, the smaller first adjusting values being smaller than or equal to 0 are applied to the protrusion deviation values and the recess deviation values;

wherein, the farther the targeted positions on the protrusive points and the recessed points on the downstream side of the reference position in the moving orientation are separated from the reference position, the greater first adjusting values being greater than or equal to 0 are applied to the protrusion deviation values and the recess deviation values;

wherein, the farther the targeted positions on the protrusive points and the recessed points on the upstream side of the reference position in the moving orientation are separated from the reference position, the greater second adjusting values being greater than or equal to 0 are applied to the protrusion deviation values and the recess deviation values;

wherein, the farther the targeted positions on the protrusive points and the recessed points on the downstream side of the reference position in the moving orientation are separated from the reference position, the smaller second adjusting values being smaller than or equal to 0 are applied to the protrusion deviation values and the recess deviation values;

wherein, in the second discharging step, the protrusion deviation values and the recess deviation values are adjusted by adding the first adjusting values; and

wherein, in the third discharging step, the protrusion deviation values and the recess deviation values are adjusted by adding the second adjusting values.

8. The inkjet printer according to claim **7**,

wherein, in the first discharging step, the controller manipulates the recording head to discharge the ink toward the targeted position in a transitional position between adjoining protrusive point and recessed point at the first discharging timing, which is deviated from the reference value for a length corresponding to a deviation value, the deviation value being obtained by filling a predetermined interpolating function with the protrusion deviation value and the recess deviation value for the adjoining protrusive point and recessed point; and

wherein, in the second discharging step, the controller manipulates the recording head to discharge the ink toward the targeted position in the transitional position at the second discharging timing, which is deviated from the reference value for a length corresponding to a first adjusted deviation value, the first adjusted deviation value being obtained by filling the predetermined interpolating function with the protrusion deviation value and the recess deviation value adjusted by the first adjusting values for the adjoining protrusive point and recessed point; and

wherein, in the third discharging step, the controller manipulates the recording head to discharge the ink toward the targeted position in the transitional position at the third discharging timing, which is deviated from the reference value for a length corresponding to a second adjusted deviation value, the second adjusted deviation value being obtained by filling the predetermined interpolating function with the protrusion deviation value and the recess deviation value adjusted by the second adjusting values for the adjoining protrusive point and recessed point.

9. The inkjet printer according to claim **1**,

wherein the corrugation mechanism is configured to the sheet into the corrugated shape having a plurality of protrusive points, at which tendency of the amount of the gap between the recording head and the sheet turns from decreasing to increasing, and a plurality of recessed points, at which the tendency of the amount of the gap between the recording head and the sheet turns from increasing to decreasing, the protrusive points and the recessed points being formed alternately along the main scanning direction;

wherein the target position toward which the ink is discharged in the discharging step includes a plurality of targeted positions on the protrusive points and the recessed points.

10. The inkjet printer according to claim **9**, further comprising:

a memory device configured to store:

a reference value indicating a reference discharging timing;

a plurality of protrusion deviation values used to delay the first discharging timing for the protrusive points from the reference discharging timing;

a plurality of recess deviation values used to advance the first discharging timing for the recessed points from the reference discharging timing; and

a plurality of adjusting values used to adjust the protrusion deviation values and the recess deviation values;

wherein the farther the targeted positions on the protrusive points and the recessed points being separated from the reference position toward the upstream side of the reference position with regard to a moving orientation of the carriage, the more largely the protrusion deviation values and the recess deviation values being decreased; and the farther the targeted positions on the protrusive points and the recessed points being separated from the reference position toward the downstream side of the reference position with regard to the moving orientation of the carriage, the more largely the protrusion deviation values and the recess deviation values being increased;

wherein, in the first discharging step, the controller manipulates the recording head to discharge the ink toward the targeted positions on the protrusive points and the recessed points at the first discharging timings, which are deviated from the reference value for lengths corresponding to the protrusion deviation values and the recess deviation values; and

wherein, in the second discharging step, the controller manipulates the recording head to discharge the ink toward the targeted positions on the protrusive points and the recessed points at the second discharging timings, which are deviated from the reference value for lengths corresponding to the protrusion deviation values adjusted by the adjusting values and the recess deviation values adjusted by the adjusting values.

11. The inkjet printer according to claim **10**,

wherein, the farther the targeted positions on the protrusive points and the recessed points on the upstream side of the reference position in the moving orientation are separated from the reference position, the smaller adjusting values being smaller than or equal to 0 are applied to the protrusion deviation values and the recess deviation values;

wherein, the farther the targeted positions on the protrusive points and the recessed points on the downstream side of the reference position in the moving orientation are separated from the reference position, the greater adjusting values being greater than or equal to 0 are applied to the protrusion deviation values and the recess deviation values;

wherein the protrusion deviation values and the recess deviation values are adjusted by adding the adjusting values.

12. The inkjet printer according to claim **11**,

wherein, in the first discharging step, the controller manipulates the recording head to discharge the ink toward the targeted position in a transitional position between adjoining protrusive point and recessed point at the first discharging timing, which is deviated from the reference value for a length corresponding to a deviation value, the deviation value being obtained by filling a predetermined interpolating function with the protrusion deviation value and the recess deviation value for the adjoining protrusive point and recessed point; and

wherein, in the second corrected discharging step, the controller manipulates the recording head to discharge the ink toward the targeted position in the transitional position at the second discharging timing, which is deviated from the reference value for a length corresponding to an adjusted deviation value, the adjusted deviation value being obtained by filling the predetermined interpolating function with the protrusion deviation value and the recess deviation value adjusted by the adjusting values for the adjoining protrusive point and recessed point.

13. The inkjet printer according to claim **10**,

wherein the reference value indicates a length of time period, which is required for the ink discharged from the recording head to land on a center position among the protrusive points and the recessed points on the sheet;

wherein the protrusion deviation values indicate distances between a reference discharging position, at which the recording head should discharge the ink toward the center position, and protrusion-targeted discharging positions, at which the recording head should discharge the ink toward the protrusive points, along the scanning direction;

wherein the recess deviation values indicate distances between the reference discharging position and recess-targeted discharging positions, at which the recording head should discharge the ink toward the recess points, along the scanning direction;

wherein the adjusting values indicate distances which adjust the protrusion deviation values and the recess deviation values according to the shape of the sheet;

wherein the controller calculates the first discharging timing by dividing the protrusion deviation values and the recess deviation values by a moving velocity of the carriage and adding the quotients to the reference value; and

wherein the controller calculates the second discharging timing by dividing the protrusion deviation values adjusted by the adjusting values and the recess deviation values adjusted by the adjusting values by the moving velocity of the carriage and adding the quotients to the reference value.

14. The inkjet printer according to claim **1**,

wherein the conveyer comprises:

an ejection roller unit, the ejection roller unit being disposed on a downstream side of the carriage in the conveyance direction and being configured to nip the sheet conveyed by the conveyer roller unit and convey the sheet along the conveyance direction,

wherein the corrugating position, in which the corrugation mechanism shapes the sheet into the corrugated shape, is on a downstream side of the ejection roller unit in the conveyance direction;

wherein the steps to be executed by the controller further comprise a detecting step, in which a position of a leading end of the sheet is detected;

wherein, in the recording step, while the position of the leading end of the sheet detected in the detecting step indicates that the leading end has not passed through the corrugating position, the controller executes the second discharging step; and

wherein, in the recording step, while the position of the leading end of the sheet detected in the detecting step indicates that the leading end has passed through the corrugating position, the controller executes the first discharging step.

15. The inkjet printer according to claim **1**,

wherein, in the second discharging step, the controller manipulates the recording head to discharge the ink toward the targeted position on the sheet of a first type, at the second discharging timing, which is deviated from the first discharging timing more largely than the second discharging timing to discharge the ink toward the sheet of a second type, the second type being a type of the sheet, of which rigidity is greater than the first type.

16. The inkjet printer according to claim **1**,

wherein, in the second discharging step, the controller manipulates the recording head to discharge the ink toward the targeted position on the sheet in a first-typed alignment, in which fiber contained in the sheet aligns along the conveyance direction, at the second discharging timing, which is deviated from the first discharging timing more largely than the second discharging timing to discharge the ink toward the sheet in a second-typed alignment, in which fiber contained in the sheet aligns to intersect with the conveyance direction.

17. The inkjet printer according to claim **1**, further comprising:

a temperature sensor,

wherein, in the second discharging step, the controller manipulates the recording head to discharge the ink toward the targeted position on the sheet, when temperature measured by the temperature sensor is higher than a predetermined threshold, at the second discharging timing, which is deviated from the first discharging timing more largely than the second discharging timing to discharge the ink toward the sheet when the temperature is lower than or equal to the threshold.

18. The inkjet printer according to claim **1**, further comprising:

a humidity sensor,

wherein, in the second discharging step, the controller manipulates the recording head to discharge the ink toward the targeted position on the sheet, when humidity measured by the humidity sensor is higher than a predetermined threshold, at the second discharging timing, which is deviated from the first discharging timing more largely than the second discharging timing to discharge the ink toward the sheet when the humidity is lower than or equal to the threshold.

19. The inkjet printer according to claim **1**, further comprising

a platen configured to support the sheet being conveyed by the conveyer;

wherein the corrugation mechanism comprises:

a plurality of contact pieces arranged on an upstream side of the recording head with regard to the conveyance direction in positions spaced apart from one another along the scanning direction, the plurality of contact pieces being arranged to be in contact with an upper surface of the sheet; and a plurality of ribs formed on the platen and arranged to contact a lower surface of the sheet at upper positions with respect to lower ends of the contact pieces,

wherein the plurality of contact pieces and the plurality of ribs are arranged alternately along the main scanning direction.

20. The inkjet printer according to claim **1**,

wherein the controller repeats the conveying step and the recording step alternately.

21. A method to record an image on a sheet in an inkjet printer, comprising steps of:

conveying the sheet by a conveyer; and

recording by moving a carriage in a scanning direction, and manipulating a recording head mounted on the carriage to discharge ink toward the sheet shaped into a corrugated shape along the scanning direction at a corrugating position,

wherein the step of recording comprises:

a first discharging step, in which, after the conveying step and on condition that the sheet is present at the corrugating position, the recording head is manipulated to discharge the ink toward a targeted position on the sheet along the scanning direction at a first discharging timing; and

a second discharging step, in which, after the conveying step and on condition that the sheet is absent at the corrugating position, the recording head is manipulated to discharge the ink toward the targeted position on the sheet along the scanning direction at a second discharging timing which is deviated from the first discharging timing, the farther the targeted position being separated from a reference position on the sheet along the scanning direction, the more largely the second discharging timing being deviated from the first discharging timing.

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